

**Conseil général des pêches
pour la Méditerranée (CGPM)**

**General Fisheries Council
for the Mediterranean (GFCM)**

Rapport de la

**QUATRIÈME CONSULTATION TECHNIQUE
SUR L'ÉVALUATION DES STOCKS
DANS L'ADRIATIQUE**

Report of the

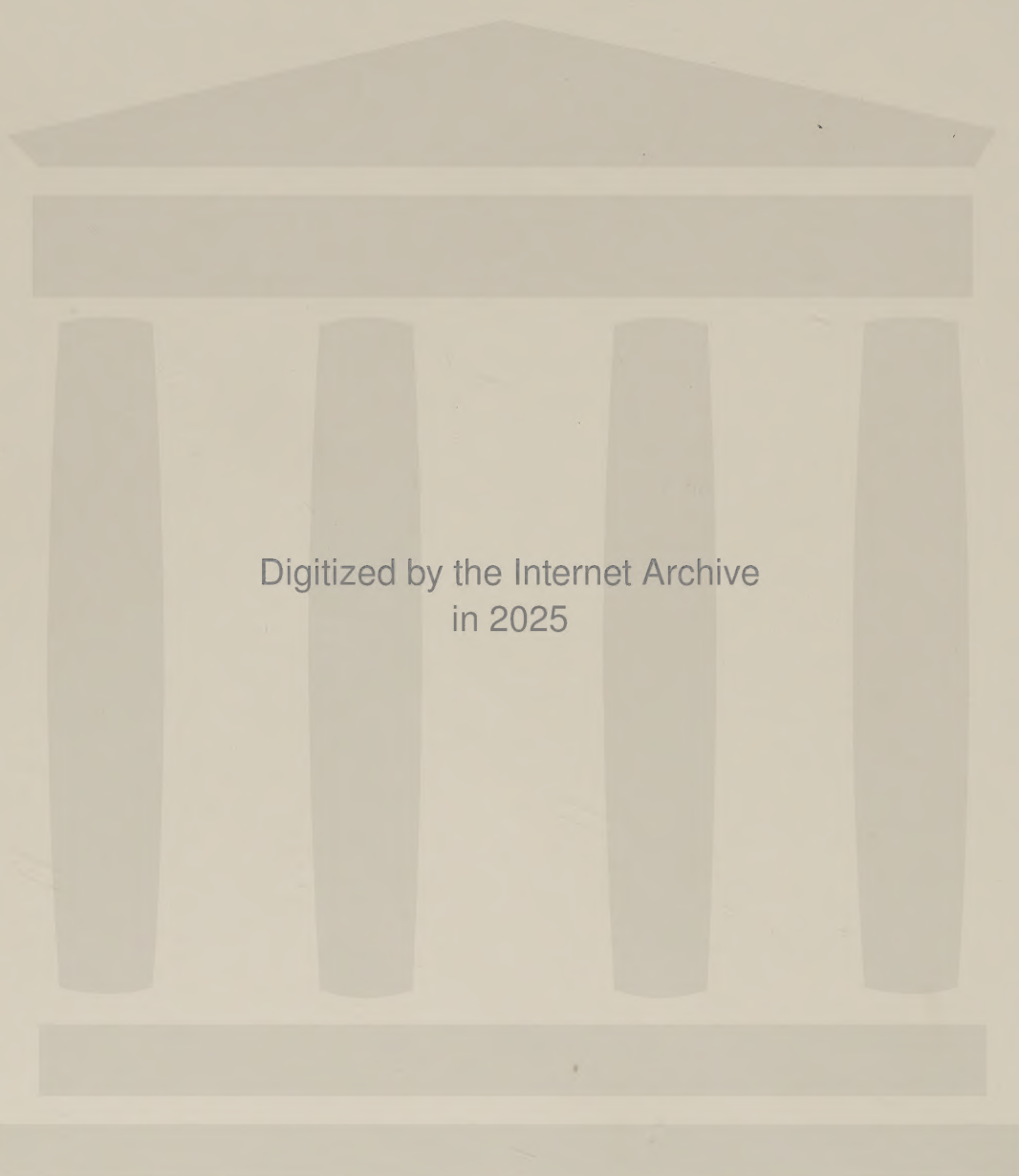
SEP 9 1986
National Marine Fisheries Service
2570 Dole Street
Honolulu, Hawaii

**FOURTH TECHNICAL CONSULTATION
ON STOCK ASSESSMENT
IN THE ADRIATIC**

Split, Yougoslavie/Yugoslavia, 7-11 octobre/October 1985



ORGANISATION DES NATIONS UNIES POUR L'ALIMENTATION ET L'AGRICULTURE
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS



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RAPPORT DE LA QUATRIEME CONSULTATION TECHNIQUE
DU CONSEIL GENERAL DES PECHEES POUR LA MEDITERRANEE
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REPORT OF THE FOURTH TECHNICAL CONSULTATION
OF THE GENERAL FISHERIES COUNCIL FOR THE MEDITERRANEAN
ON STOCK ASSESSMENT IN THE ADRIATIC

Split, Yugoslavia, 7-11 October 1985

Edité par/Edited by

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M-43

ISBN 92-5-002413-1

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PREPARATION DU PRESENT RAPPORT

Le présent texte constitue la version définitive du rapport que la Consultation technique sur l'évaluation des stocks dans l'Adriatique a approuvé à sa quatrième session.

Les bibliographies des annexes sont telles que présentées par les auteurs.

PREPARATION OF THE PRESENT REPORT

The present text is the final version of the report approved by the Technical Consultation on Stock Assessment in the Adriatic at its Fourth Session.

The bibliographies in the annexes are as presented by the authors.

Distribution

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la FAO/FAO Regional Fishery Officers

La référence bibliographique de ce document
doit être donnée ainsi/For bibliographic
purposes this document should be cited as
follows:

Charbonnier, D. et/and S. Garcia (Eds), Rapport
1986 de la quatrième Consultation technique du Conseil général des pêches pour la Méditerranée sur l'évaluation des stocks dans l'Adriatique, Split, Yougoslavie, 7-11 octobre 1985. Report of the fourth Technical Consultation of the General Fisheries Council for the Mediterranean on stock assessment in the Adriatic. Split, Yugoslavia, 7-11 October 1985. FAO Rapp.Pêches/FAO Fish.Rep., (345):204 p.

RESUME

La réunion a passé en revue les progrès réalisés en matière d'évaluation des stocks dans l'Adriatique depuis 1983. Les principaux sujets abordés ont été la constitution d'une base de données biologiques, l'amélioration de la collecte des statistiques, l'état des stocks démersaux et pélagiques, les problèmes des pêcheries côtières, les aspects socio-économiques de la pêche et l'harmonisation des législations. La consultation a adopté une série de directives et de recommandations en matière de recherche, de statistiques, de collaboration sous-régionale et d'aménagement. Elle a fait des propositions concrètes sur l'organisation de la prochaine réunion prévue à Bari, Italie, en 1987.

SUMMARY

The meeting reviewed the progress made in stock assessment in the Adriatic since 1983. The main topics considered were the establishment of a biological data base, the improvement of statistics collection, the state of demersal and pelagic stocks, the problem of coastal fisheries, the socio-economic aspects of the fishery and the harmonization of legislations. The consultation adopted a series of directives and recommendations in the fields of research, statistics, sub-regional collaboration and management. It made concrete proposals for the organization of its next meeting planned to be held in Bari, Italy, in 1987.

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I. INTRODUCTION

1. La quatrième Consultation technique sur l'évaluation des stocks dans l'Adriatique s'est tenue à Split, du 7 au 11 octobre 1985, à l'aimable invitation du Gouvernement yougoslave.
2. Le Secrétaire du CGPM a ouvert la réunion et remercié, au nom du Directeur général de la FAO, les autorités locales, et en particulier le maire de Split, M. Drago Urličić, et le directeur de l'Institut d'océanographie et de pêche, M. Perica Cetinić des efforts qu'ils avaient déployés pour l'organisation de la consultation. Il s'est félicité du nombre élevé de participants et, particulièrement, du fait que les quatre pays intéressés, Albanie, Grèce, Italie et Yougoslavie aient été, pour la première fois, tous représentés à la consultation.
3. MM. Cetinić et Urličić ont, tour à tour, souhaité la bienvenue aux participants et exprimé leurs vœux de succès pour cette rencontre. Ils ont souligné l'importance de cette consultation sous-régionale pour l'aménagement correct des ressources halieutiques de l'Adriatique qui présentent un intérêt, en particulier économique, très important pour la Yougoslavie.
4. L'ordre du jour reproduit à l'annexe A a été adopté.
5. M. S. Jukić a été élu président de la consultation, et MM. C. Papaconstantinou et E. Kapidani vice-présidents.
6. La liste des participants constitue l'annexe B.
7. Les titres des documents présentés à la consultation sont donnés à l'annexe C.

II. LA BASE DE DONNÉES BIOLOGIQUES: PROGRES REALISES

A. Eléments descriptifs du milieu

8. Atlas hydrologique ^{1/}. La constitution de l'Atlas et de la Base de données informatisée s'est poursuivie dans le cadre d'une collaboration italo-yougoslave pourtant ralentie en 1985, faute de moyens. La Base de données adriatique (B.D.A.) réalisée en Italie contient maintenant plus de 8 300 stations et sa structure est décrite (la Base yougoslave réalisée en parallèle en contient environ 9 000). Une analyse statistique des valeurs moyennes (typiques) et de leur précision statistique a été effectuée pour les données de température. Les procédures de contrôle et de correction des données sont également décrites. Le groupe informel travaillant sur ce sujet s'est agrandi et comprend actuellement onze personnes et équipes nationales travaillant en parallèle après avoir échangé leurs données (cf. paragraphe 9 du rapport de la troisième consultation).
9. Protocole méthodologique (cf. paragraphe 9 du rapport de la troisième consultation). Le protocole destiné à normaliser les procédés de collecte des données du milieu n'a pas encore pu être préparé. La nécessité de toujours calculer les intervalles de confiance des paramètres mesurés a été reconnue. Il a été également signalé qu'en décembre 1985 aura lieu en Italie une réunion pour la mise au point de fiches méthodologiques types. Il a enfin été souligné qu'il existe de sérieux problèmes d'étalonnage des équipements de mesure de précision. La recommandation de la troisième consultation a été reconduite (cf. paragraphe 13 du rapport de la troisième consultation).
10. Séries chronologiques longues. Les séries chronologiques permettant d'analyser les variations interannuelles climatiques dans l'Adriatique n'ont pas encore été compilées pour la réunion. Certaines sont déjà publiées dans des documents spécialisés et il a été demandé que les références en soient données. Il a été également précisé qu'il serait utile pour les biologistes de disposer non seulement des données brutes mais aussi d'une analyse des variations périodiques, car ces variations risquent de se retrouver dans les phénomènes biologiques fondamentaux comme le recrutement.

1/ Voir annexes D et E, et annexe C, document 26

11. Au cours de la discussion qui a suivi l'exposé plusieurs points ont été soulignés, à savoir:

- les biologistes ont besoin d'une description des situations géographiques et saisonnières "types" ainsi que d'une identification des "anomalies" climatiques. De même, il leur faut connaître les séries chronologiques et les années de séries d'années anormales;
- certains chercheurs physiciens souhaitent obtenir le concours d'un statisticien pour l'élaboration de la base de données;
- l'importance des fronts thermohalins détectés dans l'Adriatique nord.

B. Atlas des pêcheries de la Méditerranée occidentale et centrale

12. Après un bref rappel des objectifs et de l'historique de l'Atlas il a été indiqué que les zones de reproduction des pélagiques devaient être revues car des informations précises sont disponibles permettant d'améliorer très sensiblement l'information reportée dans l'Atlas. S. Regner a accepté de préparer une ébauche qui sera mise en annexe au rapport de la présente réunion et conservée pour être utilisée lors de la préparation de la version ultérieure de l'Atlas.*

13. On a également insisté sur le fait que l'Atlas actuel n'était qu'une version provisoire que tous pouvaient utiliser comme document de travail en vue de son amélioration progressive.

C. Atlas des stocks de l'Adriatique
(cf. paragraphe 15 du rapport de la troisième consultation)

14. Cet Atlas détaillé, dont il avait été fait mention lors de la précédente session, n'a pas encore pu être préparé.

D. Résumé des paramètres biologiques

15. Certains des documents présentés à la consultation contiennent des paramètres biologiques récemment estimés et qui sont résumés dans le tableau 1, pour mémoire.

Espèce	K	l_{∞}	t_0	Z	$W = aL^b$
<u>Merluccius merluccius</u> (H)				0,85-1,37	
<u>Merluccius merluccius</u> (J)	0,070	64,2		0,72	$a = 6 - 12 \times 10^{-6}$ $b = 3,00 - 3,16$
<u>Mullus barbatus</u> (I)				1,45-1,64	
<u>Solea vulgaris</u> ♂ (P)	0,069	23,2	-1,66		
<u>Solea vulgaris</u> ♀	0,042	37,9	-5,36		
<u>Solea vulgaris</u> ♂	0,041	38,2	-3,57		
<u>Engraulis encrasicolus</u> (T)					$a = 1,56 - 1,82$ $b = 2,87 - 2,88$

Note: Les lettres entre parenthèses indiquent l'annexe d'où proviennent les données.

* Cette ébauche n'est pas parvenue au Secrétariat.

III. PROGRES ACCOMPLIS DANS LE DOMAINE DES STATISTIQUES DE PECHE

16. Italie: Les objectifs du programme PESTAT ont été rappelés. Le rapport final concernant l'inventaire des flottilles a été publié. A la demande du représentant de la CEE il a été indiqué que la seconde partie du travail, conduisant à l'évaluation des captures et de l'effort de pêche, était presque terminée et que les résultats seraient disponibles dès le début de l'année 1986. Les nouveaux formulaires mis en place par l'ISTAT ^{2/} pour l'enregistrement des navires et de leurs caractéristiques devraient permettre dorénavant une mise à jour plus efficace du registre de la flotte italienne. A la demande également du représentant de la CEE il a été confirmé que les nouvelles procédures devraient sensiblement améliorer la fiabilité des statistiques concernant la flotte italienne, mais que des efforts continus seront toujours nécessaires pour assurer un contrôle technique efficace du nouveau système.

17. Yougoslavie: Les problèmes rencontrés au sein du Département des statistiques à Zagreb et rapportés lors de la précédente session n'ont pas encore été résolus et il n'existe toujours pas de données officielles sur les statistiques de capture et d'effort des flottes artisanales (petits métiers) et privées (voir paragraphe 98).

18. Pêche aux petits métiers: Pour tenir compte des recommandations du CGPM, l'ordre du jour faisait une place importante aux pêches artisanales et lagunaires; cependant peu de documents ont été présentés pour stimuler une discussion sur les problèmes relatifs à ces pêcheries.

19. Une description des pêcheries artisanales italiennes a été faite ^{3/} qui montre la différence entre les métiers pratiqués dans le nord de l'Adriatique où l'on utilise les dragues hydrauliques (pour les bivalves) et les filets maillants (pour la plie et les seiches); dans l'Adriatique centrale où l'on utilise davantage les nasses, et dans l'Adriatique méridionale où l'on emploie à nouveau davantage les engins fixes et les longues lignes (palangres) pour les espadons et les thons. Les données de capture et d'effort, également fournies, proviennent en partie du programme PESTAT et d'études particulières entreprises par l'IRPEM d'Ancône.

20. Il a encore une fois été souligné que, dans l'Adriatique nord, la présence des chalutiers de gros tonnage (jusqu'à 400 ch) dans la zone côtière (à moins d'un mille du rivage) crée une situation intenable pour les petits métiers.

IV. ETAT DES STOCKS DEMERSAUX

21. Bien que la situation concernant les statistiques de pêche sur les deux rives de l'Adriatique soit toujours préoccupante, de gros progrès ont été faits grâce aux données collectées lors des campagnes de chalutage scientifique.

A. Mise à jour des données de capture et d'effort

22. Aucune information n'a été fournie à la consultation.

B. Modèles de production

23. Un modèle de production "multispécifique" a été présenté ^{4/}. Basé sur le modèle de Fox appliqué à 12 espèces de l'Adriatique yougoslave, ce modèle utilise un programme de calcul de programmation non linéaire pour résoudre simultanément les 12 équations de Fox correspondant aux 12 espèces. "L'optimum" défini par l'auteur est l'effort de pêche pour lequel la plus grande capture possible est obtenue sans que l'un des 12 stocks considérés ensemble soit sévèrement surpêché. Appliqué aux ressources de la Yougoslavie (avec les seules données de capture et d'effort de ce pays) ce modèle permet à l'auteur d'obtenir des captures "optimales" par stock et de montrer que l'effort appliqué en moyenne ces dernières années est trop élevé (par rapport au critère retenu par l'auteur comme optimum).

^{2/} Voir annexe F

^{3/} Voir annexe G

^{4/} Voir annexe C, document 17

24. Il convient cependant de remarquer que la portée pratique de cette analyse serait sérieusement limitée si les variations d'abondance du stock (ou sous-stock) exploité par la Yougoslavie étaient dues davantage aux variations de l'effort de pêche italien (de beaucoup le plus important) qu'à celles de l'effort de pêche yougoslave.

C. Autres évaluations

25. Des résultats nouveaux et très intéressants ont été obtenus grâce aux campagnes de chalutage scientifique.

Merluccius merluccius en Adriatique nord et centrale 5/

26. Le document présenté montre que le stock est très fortement surexploité. La plupart des valeurs obtenues pour la mortalité totale oscillent autour de $Z = 1/\text{an}$. La mortalité naturelle de cette espèce étant d'environ $M = 0,2 - 0,3$, il en découle que $F = 0,7 - 0,8/\text{an}$ soit 2,5 à 4 fois la valeur de M . Le taux d'exploitation serait de $E = F/Z = 0,75$ environ. La taille de première capture varie avec la profondeur, la saison, etc. Cependant, les jeunes de chaque cohorte sont capturés tout d'abord dans les nurseries (vers 200 m de profondeur) à une taille de 8 cm (LT). Avec une telle taille de première capture, le document montre que des bénéfices substantiels, en poids et en valeur, seraient obtenus si l'on pouvait augmenter le ou réduire F .

27. Il a été souligné que le fait que les poissons soient capturés trop petits est une conséquence et non la cause première de la surpêche qui est l'excédent d'effort de pêche. Une stratégie visant à protéger les jeunes (c'est-à-dire à faire disparaître les conséquences de la surpêche) sans réduire l'effort (c'est-à-dire sans attaquer le mal à sa racine) est vouée à l'échec et se trouvera confrontée au coût excessif du contrôle et de la surveillance nécessaires à l'application d'une mesure économiquement difficile à appliquer.

Merluccius merluccius en Adriatique méridionale

28. Une courte note 6/ a présenté les résultats obtenus sur le merlu au large des côtes méridionales de l'Adriatique. Il est intéressant de noter que les structures de taille observées (et donc la mortalité totale et par pêche) sont très similaires, ce qui confirme que la pression de pêche exercée dans la zone sud est voisine de celle exercée plus au nord et analysée plus en détail (voir paragraphe 26).

Mullus barbatus en Adriatique nord et centrale 7/

29. Des études similaires effectuées sur cette espèce ont conduit à des estimations de $Z = 1$ à 2 par an avec une moyenne de $Z = 1,6$. En outre les valeurs de Z pour le groupe 0 atteindraient $Z = 2$ à 4 par an. Bien que ces dernières valeurs soient à considérer avec prudence, elles tendent à confirmer les très hautes mortalités appliquées aux juvéniles de cette espèce de l'été à l'automne sur les côtes italiennes. Si l'on admet en première approximation une valeur de $M \sim 0,4/\text{an}$ pour cette espèce on aurait donc des taux d'exploitation $E = F/Z$ de 0,75, similaires à ceux obtenus pour le merlu et indiquant encore un état de sévère surexploitation. Les valeurs élevées de Z sur les jeunes, si elles sont vérifiées, prouveraient ce que l'on sait déjà, c'est-à-dire que les tout petits sont extrêmement vulnérables et subissent une pression de pêche excessive.

30. Le problème des variations apparentes importantes du recrutement a été discuté. La solution à ce problème consiste, étant donné que l'effort de pêche est relativement constant, à établir des distributions de tailles (et d'âges) moyens sur plusieurs années au fur et à mesure que la base de données s'améliore, et à calculer des valeurs de Z moyennes à partir de ces données.

5/ Voir annexe H

6/ Voir annexe AA

7/ Voir annexe I

31. Le problème de la contribution respective des nurseries italiennes et yougoslaves au recrutement du stock commun de Mullus barbatus a été brièvement abordé. Il a été indiqué que, compte tenu du fait que les biocoenoses caractéristiques des nurseries à rougets barbeta sont presque exclusivement sur la côte italienne, on peut admettre en première hypothèse que la grande majorité des recrues vient d'Italie. On a en outre souligné qu'on trouve très rarement, dans la zone des chenaux de Yougoslavie, des concentrations de rougets de petite taille.

32. Il a été enfin déclaré que l'âge de première capture du rouget en Yougoslavie est bien supérieur à celui qui est la règle en Italie.

Merluccius merluccius des côtes grecques 8/

33. Une étude similaire à celle réalisée dans l'Adriatique nord et entreprise dans les golfes de Patraikos et Korinthis et en mer Ionienne sur la base de campagnes expérimentales de chalutage a montré qu'avec des mortalités totales de $Z = 0,72$, et par pêche de $F = 0,53$, les stocks sont très fortement surexploités ($E = 0,74$).

Mullus barbatus des côtes grecques 9/

34. Une étude similaire à la précédente, réalisée dans le même secteur, a conduit à des valeurs de $Z = 0,68$, $F = 0,51$ et $E = F/Z = 0,73$.

35. On peut noter que dans cette zone également, des taux d'exploitation excessifs ($E = 0,70 - 0,75$) sont appliqués aux ressources traditionnelles, tout comme en Adriatique où des valeurs similaires ont été obtenues.

Chlamys opercularis et Pecten jacobaeus (Adriatique) 10/

36. Le document présenté fait état d'une importante ressource potentielle de la première espèce dans l'Adriatique nord. Ce stock est peu pêché à l'heure actuelle dans la partie sud de son aire de répartition et mérite donc une certaine attention bien qu'il soit très connu des pêcheurs. Le facteur limitant son exploitation pour le moment semble être le marché.

37. On a souligné l'intérêt de cette étude sur un stock peu exploité en retenant toutefois que l'effet de la pêche, qu'il soit direct (dans certains secteurs où les espèces sont exploitées) ou indirect (mortalité par "casse" due au chalutage intense) doit être étudié.

Espèces accessoires 11/

38. Une courte note préliminaire a été présentée, se référant aux variations saisonnières de cpue des espèces non commerciales dans les golfes de Patraikos et de Korinthis et dans la mer Ionienne.

D. Questions relatives aux campagnes de chalutage

Variations de capturabilité 12/

39. Une étude détaillée des variations de capturabilité nyctémérale a été effectuée. Elle vient à point pour documenter le problème des sources de variabilité affectant les données obtenues par campagnes de chalutage. Il a été indiqué que ces variations sont importantes et de nature à biaiser les résultats et réduire leur précision si elles ne sont pas prises en compte dans les plans de campagne et/ou au cours de la stratification des données pour le traitement statistique.

40. Il a été souligné que, lorsque l'ensemble du stock démersal est considéré pour une étude, celle-ci devrait comporter des chalutages de jour comme de nuit afin de ne pas biaiser systématiquement les évaluations d'abondance de certaines espèces.

8/ Voir annexe J

9/ Voir annexe K

10/ Voir annexe L

11/ Voir annexe M

12/ Voir annexe N

Stocks de *Chamelea gallina* (petite praire)

41. Une note préliminaire ^{13/} a été présentée à ce sujet. Elle fournit une évaluation préliminaire des biomasses minimales mesurées en 1984 par prospections scientifiques à l'aide d'une drague hydraulique entre Monfalcone et Caorle et entre Goro et Barletta. Les densités observées varient de 2 à 52 kg par 1 000 m². Les résultats sont considérés comme très provisoires.

Méthodologies des prospections

42. Une discussion s'est instaurée sur les méthodologies appropriées pour l'évaluation des stocks, en référence au rapport initial "Statistical considerations in the design of trawl surveys" préparé par M. Fogarty (FAO Fish.Circ., 786, 1985) après les ateliers organisés à Fano et à Mazara del Vallo en 1984. La discussion a porté encore une fois sur le problème des plans d'échantillonnage et, en particulier, sur les avantages et inconvénients respectifs des plans systématiques et aléatoires stratifiés ^{14/}. Des opinions diamétralement opposées ont été émises quant à ces deux méthodologies.

43. Le Secrétaire technique a rappelé que le problème était un problème méthodologique qui ne relevait pas du domaine de l'"opinion" mais de celui de l'analyse quantitative avec les méthodes éprouvées qui s'y rattachent. Il a rappelé que les ateliers de Fano et de Mazara avaient été organisés pour couper court à des discussions peu profitables et établir les bases objectives d'un choix de méthodologies qui satisfassent aux conditions scientifiques et qui permettent d'atteindre les objectifs assignés aux prospections; il appartenait donc à chacun d'en tirer les conséquences, et à la communauté scientifique de juger des résultats obtenus. Le Secrétaire a seulement rappelé qu'il était impératif que les estimations soient toujours accompagnées de leur intervalle de confiance et que de tels calculs n'étaient pas possibles pour l'instant avec un échantillonnage purement et rigoureusement systématique. Les manuels actuellement disponibles sont formels sur ce point.

Lecture de l'âge chez les poissons plats (pleuronectiformes) ^{15/}

44. Il a été démontré que, pour plusieurs espèces de poissons plats de l'Adriatique, les zones hyalines et opaques des otolithes se forment en opposition totale avec la théorie. Dans le cas de *Solea vulgaris* et d'autres espèces encore, la zone hyaline serait déposée en saison chaude et la zone opaque en saison froide, contrairement au dogme. L'hypothèse émise est que la formation de ces zones est liée à la reproduction, et non pas à la croissance et à la température. Apparemment les paramètres de croissance (K, L_∞) ne sont pas affectés mais l'âge absolu (et t₀) sont décalés de 6 mois si ce phénomène n'est pas pris en compte.

V. RESSOURCES PELAGIQUES

A. Mise à jour des données de capture et d'effort

45. Les données fournies à la consultation figurent dans le tableau 2 ci-dessous.

Tableau 2 - Captures totales de la sardine, du sprat et de l'anchois de 1981 à 1984 (tonnes)

Année	Sardine		Sprat		Anchois	
	Yougoslavie	Italie	Yougoslavie	Italie	Yougoslavie	Italie
1981	31483	41 698*	2637		2284	18 647*
1982	25728	36 592*	3822		2326	22 420*
1983	40044	33 182*	1895		945	18 300*
1984	35623	25 421**	1168		1342	13 179**

* Ports de Trieste, Chioggia, Porto Garibaldi, Cesenatico, Cattolica et Ancône.

** Ports ci-dessus, plus San Benedetto del Tronto et Vieste.

En outre en 1984, 22 997 tonnes de sardine et d'anchois ont été envoyées aux usines de farine - Toutes les données italiennes ont été recueillies par l'IRPEM, Ancône.

^{13/} Voir annexe O

^{14/} Voir annexe C, document 25

^{15/} Voir annexe P

Développement de la flotte en Yougoslavie ^{16/}

46. La flotte yougoslave a été modernisée par l'introduction de chalutiers pélagiques pêchant en boeuf. Les résultats semblent excellents. Il est prévu de rénover les senneurs actuellement en très mauvais état et de développer encore davantage la flotte des chalutiers pélagiques en étendant la zone de pêche autour des îles dalmates et en mer ouverte.

Relation entre cpue et abondance chez la sardine ^{17/}

47. Une analyse de la distribution statistique des rendements a été présentée. Les distributions des rendements journaliers sont log-normales à cause du mode de concentration des sardines. L'indice de dissymétrie (le rapport moyenne/variance) varie avec le temps (il diminue depuis 1979) et aussi du nord au sud et suivant les saisons. Il existe une bonne corrélation entre la cpue et l'indice de dissymétrie des distributions.

B: Données biologiques

Identification des stocks

48. Il s'agit là d'un problème fondamental pour l'aménagement, et des données intéressantes ont été recueillies et portées à l'attention de la consultation, dans le cas des sardines ^{18/}.

49. Le résumé des données disponibles sur cette importante question indique une bonne probabilité que le stock de l'Adriatique orientale soit constitué de deux sous-populations différentes correspondant à des zones de reproduction distinctes.

Zones de ponte de la sardine et de l'anchois ^{19/}

50. Des informations supplémentaires dans le domaine de la reproduction des pélagiques ont été obtenues à partir de campagnes qui, pour la première fois, ont couvert toute l'Adriatique italienne et, en particulier, la zone au sud du Gargano. Les campagnes ont confirmé que la zone de ponte principale de l'anchois se trouve dans l'Adriatique nord. Pour la sardine, des zones de reproduction intense sont observées dans l'Adriatique centrale mais aussi dans l'Adriatique méridionale au sud du Gargano. Une continuité entre les deux zones principales de ponte du nord et du sud de l'Adriatique a été observée. Ceci implique la nécessité d'une couverture globale de l'Adriatique pour estimer le stock de pélagiques.

51. Au cours d'une discussion sur les possibilités de reproduction de l'anchois en hiver il a été souligné que, sauf accident très rare, la reproduction de cette espèce mesurée par la présence des oeufs est limitée à la période printemps-été.

52. Deux courtes notes ont également été présentées sur les relations biométriques chez la sardine ^{20/} et les structures d'aggrégation des bancs de sardine dans les eaux de l'Adriatique ^{21/}. Là également la distribution de la taille des bancs apparaît log-normale et les principales caractéristiques de ces bancs sont décrites.

C. Estimations directes de la biomasse

53. Les progrès réalisés à l'IRPEM d'Ancône dans l'identification des bancs de petits pélagiques ont été exposés. Les résultats obtenus de 1978 à 1982 montrent un changement de dominance après 1981 avec passage d'un stock dominé par l'anchois avant 1981 à un stock dominé par les sardines en 1981 et 1982. Ces résultats obtenus par analyse des données de prospection acoustique sont confirmés par les données collectées au débarquement qui montrent les mêmes renversements de tendance au niveau des marchés.

^{16/} Voir annexe Q

^{17/} Voir annexe R

^{18/} Voir annexe S

^{19/} Voir annexe T

^{20/} Voir annexe U

^{21/} Voir annexe V

54. Au cours de la discussion, on a indiqué que les variations apparentes qui pourraient correspondre à des déplacements nord-sud des centres de gravité respectifs des stocks de sardine et d'anchois sont plus vraisemblables dus à des oscillations du recrutement et de la biomasse en fonction de l'environnement.

D. Protection des stocks de juvéniles en Adriatique ^{22/}

55. Le document présenté souligne l'existence de nurseries de sardines dans les baies de Karin et de Novigrad et de variations interannuelles d'abondance des juvéniles dans ces nurseries où les captures sont parfois importantes, même dans les tailles inférieures à la taille minimale légale.

56. Il a été indiqué que ces baies ne constituent qu'une partie de la totalité des nurseries disponibles sur les côtes italienne et yougoslave et que les variations qui y étaient observées n'étaient pas forcément représentatives des variations globales du recrutement dans l'Adriatique. Il a cependant été reconnu que cette hypothèse valait la peine d'être testée et des études sont en cours.

57. La discussion a ensuite porté sur le problème de la protection des juvéniles et on a fait référence au "bianchetto" d'Italie et à la pêche des post-larves de pélagiques en Espagne, totalement interdite il y a peu dans ce dernier pays à cause des dégâts causés par cette pêche. Il a été souligné que l'autorisation de pêcher mentionnée dans l'annexe 23 est temporaire (2 ans) et limitée à ce lieu de pêche traditionnel sous le contrôle de l'Institut de Split.

E. Estimations de l'abondance des pélagiques par les oeufs et les larves ^{23/}

58. Les résumés des travaux entrepris par les laboratoires de Split, de Fano et de Trieste ont été présentés ainsi qu'une analyse statistique des résultats obtenus depuis 1976 (valeurs de la biomasse de l'anchois et intervalles de confiance). Des variations à long terme sont mises en évidence, qui concordent assez bien avec les variations indiquées par les campagnes acoustiques. Cette concordance est peut-être le signe que les deux techniques ont atteint le degré de maturité nécessaire et qu'une comparaison fructueuse des résultats sera bientôt possible. Une stratification moyenne des abondances a été réalisée et sera utilisée à l'avenir pour établir les plans de campagne.

59. A l'issue de l'exposé il a été souligné que des progrès sont nécessaires et que des recherches seront approfondies pour mieux apprécier la fécondité réelle de la sardine et de l'anchois et le nombre de pontes par an.

60. En outre il est maintenant clair que l'on doit réduire le nombre des stations par campagne et augmenter le nombre des campagnes pour mieux couvrir la période de ponte et mieux situer la position des campagnes au sein de cette période.

VI. PROBLEMES PARTICULIERS

A. Pêcheries côtières

61. Suivant en cela les recommandations du CGPM, la consultation a accordé plus d'attention aux pêches côtières.

62. Italie: Le document présenté ^{24/} assimile la pêche côtière à toute la zone des 12 milles. Il définit les différents groupes d'espèces qui s'y trouvent et les types de pêche qui les exploitent. Il souligne que la majeure partie de l'effort de pêche italien est appliquée dans les 12 milles italiens d'où provient la plus grande partie de la biomasse capturée et que la réglementation italienne est en général peu ou pas appliquée.

^{22/} Voir annexe W

^{23/} Voir annexe X

^{24/} Voir annexe Y

63. Le document propose de tenter une expérimentation de fermeture pendant la période de recrutement, interdisant la pêche successivement dans la zone des 6 milles pendant six semaines en août/septembre et pendant six autres semaines dans la zone de six à douze milles en octobre/novembre. Cette proposition est basée sur les résultats positifs observés à Chypre ces dernières années à la suite de l'application de mesures similaires et sur les données biologiques collectées en Italie dans la zone côtière.

64. Au cours de la discussion, une objection fondamentale a été émise, à savoir que si l'expérimentation réussissait, l'amélioration de la rentabilité, très importante, que l'on peut espérer pourrait entraîner, comme à Chypre, une augmentation de l'effort de pêche jusqu'à dissipation des bénéfices créés. En conséquence, sans une politique claire préalable de limitation effective de l'effort de pêche, cette expérimentation n'apporterait pas de solution viable aux problèmes actuels.

65. L'opinion a été émise que si des fonds étaient disponibles pour une opération de ce type, il serait préférable de les investir dans des mesures visant à réduire l'effort dans la zone côtière.

66. Il a été enfin noté qu'il vaudrait mieux en tout cas faire cette expérience dans des milieux de taille réduite, semi-fermés (petites baies pratiquement indépendantes) pour assurer, à peu de frais, le succès éventuel d'une démonstration de l'efficacité de ces mesures.

67. Au cours de la discussion a été soulevé le problème de l'interaction entre l'aménagement et le développement. Il a été souligné que, sans une définition d'objectifs communs et une harmonisation des politiques tant au niveau national qu'européen, l'action des services de développement, par des programmes d'aide inconsiderés, contribuerait à alimenter la croissance incontrôlée de l'effort de pêche. Cette remarque a en particulier été faite par certains participants en ce qui concerne les requêtes de financement de la pêche italienne à la CEE.

68. Yougoslavie: un document de synthèse ^{25/} a été présenté. Il fait le point sur les données synthétiques de captures expérimentales obtenues de 1971 à 1984 en utilisant le trémail de fond. Il analyse les variations de rendement et de composition spécifique dans les diverses zones. Il indique une baisse à long terme des rendements et un changement de la composition spécifique, caractéristiques d'un effet de la surexploitation et peut-être de la pollution.

B. Etudes économiques

69. Sous cette rubrique ont été présentés deux documents abordant une étude bio-économique préliminaire du problème du changement de maillage et du passage à la maille de 40 mm en Yougoslavie et Italie. Ces deux études, qui ont été largement discutées, présentent des conclusions relativement semblables.

70. En Yougoslavie, le document ^{26/} montre que les maillages de 40 mm seraient insuffisants pour beaucoup d'espèces principales (Pagellus, Merluccius, Nephrops) et que des maillages de 55 mm, voire de 65, seraient biologiquement préférables. Il est reconnu dans ce document que les conséquences à long terme seraient positives mais que les pertes à court terme seraient trop élevées.

71. Ceci confirme tous les résultats antérieurs présentés par les divers groupes de travail du CGPM qui ont toujours indiqué que pour beaucoup d'espèces la maille de 40 mm proposée n'était qu'un minimum, et un premier pas vers un maillage plus conforme aux conditions de la Méditerranée.

25/ Voir annexe Z

26/ Voir annexe C, document 19

72. En Italie le travail présenté ^{27/} indique également qu'une maille plus grande que 40 mm serait dans bien des cas biologiquement préférable mais que les conséquences suivantes découleraient d'une application généralisée du maillage de 40 mm:

- transfert de biomasse vers le large et perte pour la zone côtière;
- gains surtout par la flotte du large (pêchant hors des six milles).

73. La consultation a cependant noté que, s'il est facile d'évaluer les conséquences à court terme, les conséquences à long terme devraient être traitées en utilisant les procédures scientifiques établies de longue date pour ce type d'analyse (Gulland, Jones, Cadima, rendement par recrue, etc.). L'analyse des gains à long terme doit être approfondie. Les données sur les structures réelles des tailles des captures de la pêche professionnelle (distribution totale annuelle des fréquences de tailles) sont fondamentales pour ce genre d'étude.

74. Il a été rappelé que l'Italie ayant accepté depuis des années la Recommandation XIII/76/1 de 1976 du CGPM sur le maillage de 40 mm se doit, comme membre du Conseil, de l'appliquer. Le délai de grâce de 2 ans accordé par les autorités italiennes étant écoulé et la procédure en trois étapes recommandée par le CGPM en 1980 étant terminée depuis le 1er octobre 1983, l'Italie devrait appliquer rigoureusement ce maillage, comme devraient également le faire les autres pays membres du CGPM.

75. Le problème de la pêche côtière a été reconnu comme un problème réel, mais il a été suggéré qu'il était nécessaire de le traiter séparément, et dans un deuxième temps, sous l'angle des alternatives à offrir à cette pêche (récifs artificiels, aquaculture littorale, emplois alternatifs, etc.) dans le cadre d'une réduction globale de l'effort de pêche inévitable dans les conditions actuelles.

76. Il a été enfin reconnu que le maillage de 50 ou 60 mm serait en fait le seul susceptible d'améliorer l'état de certains stocks pour les pêcheries du large.

77. D'une manière plus générale, il a été souligné que des travaux scientifiques abordant un problème d'aménagement aussi sérieux que le maillage devraient présenter une vue complète de ce problème (pertes à court terme et gains à long terme) pour ne pas risquer que des conseils erronés ne donnant pas un cadre complet des options possibles et de toutes leurs conséquences prévisibles, soient donnés aux autorités.

78. Il a également été indiqué que l'exemple de Chypre devait rester présent à l'esprit des chercheurs pour bien montrer que dans des situations de surexploitation grave, les modèles classiques donnent une image très sous-estimée des effets réels d'une protection efficace des juvéniles.

C. Coordination des travaux de recherche

79. La nécessité d'une telle coordination a été de nouveau soulignée avec force tout en reconnaissant que beaucoup restait encore à faire. Deux actions concrètes ont été proposées, que la consultation a appuyées sans réserves.

80. Méthodologie acoustique: L'Institut d'Ancône va organiser en octobre-novembre 1986 un stage pratique de familiarisation aux techniques de prospection acoustique et à l'utilisation des matériels. Il invitera les chercheurs concernés de l'Adriatique à y participer, et en particulier ceux de Grèce et d'Albanie qui commencent seulement à utiliser ces techniques. M. Azzali sera le coordinateur de ce stage.

81. Comparaison des méthodologies d'évaluation des pélagiques: Le degré actuel de maturité des méthodologies d'évaluation directe (par les oeufs et les larves ou l'acoustique) et indirecte (analytiques) permettent d'envisager une réunion pour comparer les résultats obtenus. Ce type de réunion a d'ailleurs été recommandé par le Conseil consultatif de la recherche sur les ressources marines (CCRRM) de la FAO. L'Institut d'Ancône a proposé d'accueillir cette réunion en 1987.

^{27/} Voir annexe C, document 11

VII. HARMONISATION DES LEGISLATIONS

82. Une note présentée ^{28/} a soulevé une fois encore le problème de l'harmonisation de l'ensemble des normes juridiques des pays exploitant une ressource commune et devant tôt ou tard aménager cette dernière en étroite concertation.

83. Ayant reconnu et confirmé à nouveau que de nombreux stocks parmi les plus importants en valeur sont des ressources d'intérêt commun exigeant un aménagement en commun, la consultation a reconnu qu'il serait utile que des progrès soient accomplis en la matière. Elle a recommandé que soit organisée rapidement une réunion de juristes des pays concernés pour lancer les bases d'une harmonisation des textes législatifs en prévision d'une gestion concertée des ressources, et demandé que le Comité du CGPM de l'aménagement des ressources inscrive ce thème de réflexion à l'ordre du jour de sa prochaine session.

VIII. DIRECTIVES ET RECOMMANDATIONS

84. La consultation a fait le point sur le suivi des directives de la précédente consultation, le travail accompli pendant l'intersession, et les directives relatives aux travaux à accomplir jusqu'à la prochaine réunion.

A. En matière de recherche

i) Stocks démersaux

85. - Utiliser les données des campagnes de chalutage pour compléter les cartes de distribution des espèces:

Cette directive a été partiellement suivie. Elle devra être poursuivie à l'avenir et les meilleures stratifications possibles devront être définies. La possibilité de stratifier par communauté de poissons devra être recherchée.

86. - Calculer les taux de mortalité à partir des fréquences des tailles:

Cette directive a été suivie au cours de l'intersession. Cet effort devra cependant être poursuivi en routine pour mieux cerner la précision des valeurs obtenues et compenser par un effet de moyenne les variations interannuelles du recrutement.

87. - Ajuster les courbes de croissance de von Bertalanffy:

Cette directive a été suivie lors de l'intersession. Elle devra être poursuivie en routine. Les études de validation de l'âge devront être renforcées. Les ellipses de confiance de K et L_∞ (la méthodologie sera fournie par le Secrétariat) devront être calculées systématiquement pour faciliter les comparaisons.

88. - Etudier la distribution géographique des âges et des tailles pour analyser les migrations

Cette directive a été suivie pour le rouget et la sardine. Elle devra être poursuivie en routine pour les autres espèces.

89. - Analyser les données de longueur dans les captures de la campagne "Hvar":

Cette directive n'a pas été suivie d'effet. Elle devra être mise en oeuvre dans les meilleurs délais.

90. - Campagnes de chalutage expérimental:

Les calculs de densité des principales espèces, globalement pour l'Adriatique, ainsi que pour les strates caractéristiques (talus, nurseries, etc.) devront être effectués en routine. Ils devront couvrir autant que possible toute l'Adriatique. Les intervalles de confiance des évaluations effectuées en appliquant les méthodes appropriées devront être estimés en routine.

^{28/} Voir annexe C, document 30

91. - Echantillonnage biologique des captures et/ou des débarquements:

Cette directive n'a pas été suivie et est difficile à suivre. Il est demandé d'essayer d'effectuer un échantillonnage minimal en période de recrutement pour déterminer l'âge et la taille de première capture ainsi qu'un échantillonnage des captures des professionnels pendant la campagne de chalutage pour déterminer la forme du vecteur de F par classe de taille 29/.

ii) Stocks pélagiques

92. - Définition des unités de stock:

Cette directive a été suivie pour la sardine. La consultation demande cependant de continuer à accumuler les preuves pour ou contre la séparation en deux sous-populations, de bien distinguer le problème de la séparation des concentrations d'oeufs de celui de la séparation des adultes, et de se pencher sur les problèmes de mélanges ou de migrations nord-sud. L'analyse des données méristiques devrait être reprise.

93. - Analyse coût-bénéfice de la pêche pélagique de Yougoslavie:

Elle devra être préparée.

94. - Les travaux sur la fécondité des petits pélagiques et la détermination du nombre de pontes par an doivent être approfondis.

95. - Comparaison des méthodes d'évaluation:

La consultation a accepté la proposition de l'IRPEM d'organiser à Ancône un atelier pour la comparaison des résultats obtenus par les diverses méthodes d'évaluation des pélagiques. Elle a souhaité que le Secrétariat y participe et y apporte son appui technique.

96. - Hydrologie/climatologie:

Une bibliographie annotée concernant les publications et documents contenant les séries chronologiques nécessaires à l'étude des variations à long terme sera préparée.

B. En matière de statistiques

97. La consultation a jugé absolument nécessaires les actions suivantes:

98. Obtenir enfin des statistiques fiables des débarquements et de la composition de la flotte par métiers pour tous les pays de la sous-région. En Yougoslavie, collecter les statistiques de la petite pêche côtière et de la pêche privée.

99. Communiquer les résultats de PESTAT II dès que possible à tous les participants.

C. En matière de collaboration sous-régionale 30/

100. Les collaborations déjà mises en oeuvre doivent se poursuivre dans les domaines suivants:

- a) campagnes d'évaluation des biomasses par la méthode des oeufs et larves,
- b) campagnes de chalutage scientifique,
- c) campagnes de prospection acoustique.

101. Pour faire progresser la collaboration dans ce dernier domaine, et étant donné qu'il est impératif de couvrir autant que possible toute la zone de distribution des stocks pélagiques, il a été proposé que soient réalisées des campagnes de prospection conjointes avec un seul bateau ayant à son bord des équipes de scientifiques de tous les pays concernés. Il a été admis que des contacts officiels devront être établis suffisamment à l'avance par l'IRPEM d'Ancône pour obtenir les autorisations nécessaires.

29/ Une note méthodologique est en préparation par le Secrétariat.
30/ Voir annexe C, document 8

102. - Stage de démonstration:

La consultation a apprécié la proposition de l'IRPEM d'organiser à Ancône un stage de démonstration sur l'utilisation du matériel acoustique (théorie, équipements, méthodes de traitement des données, etc.) en 1986.

103. - Elaboration d'une base de données hydrologiques:

Reconnaissant à nouveau l'importance de l'établissement d'un Atlas et d'une Base de données hydrologiques pour la recherche sur les ressources et leur aménagement, la consultation a insisté sur l'importance d'une collaboration plus étroite à l'avenir entre les laboratoires concernés. Pour atteindre les objectifs fixés par la consultation, des contacts fréquents entre les scientifiques sont nécessaires pour résoudre les multiples problèmes techniques qui entravent encore l'avancement des travaux. La consultation demande donc que tout soit mis en oeuvre de part et d'autre pour favoriser l'organisation d'ateliers sur l'Atlas et sur la Base de données. Un support financier sera recherché auprès de la FAO, de la COI, et de l'Unesco.

104. - Programme concerté d'études sur les petits pélagiques:

En se référant à une proposition de collaboration faite par l'IRPEM d'Ancône pour une étude concertée des petits pélagiques qui sont une ressource commune à toute la sous-région, la consultation a admis qu'il serait très important que:

- . les données de capture et d'effort soient collectées sur la base d'un recensement exhaustif, par bateau et pour toute la flotte,
- . les données soient collectées, avec la meilleure couverture possible pour le secteur privé (en Yougoslavie), en utilisant si nécessaire un plan d'échantillonnage stratifié par zone et par port,
- . un échantillonnage des longueurs soit entrepris deux fois par mois avec un échantillonnage pour la lecture de l'âge et la détermination des caractères méristiques sur la base de 10 individus par classe de longueur de 1 cm et par port.

La liste ci-dessus est donnée à titre indicatif et des contacts seront établis ultérieurement entre les chercheurs concernés pour régler les détails du programme concerné (fréquence des échantillonnages, organisation de la base des données, etc.).

D. En matière d'aménagement

105. - Régulation de l'effort de pêche:

Considérant les résultats des campagnes de chalutage jusqu'ici effectuées et la stabilité des valeurs extrêmement élevées obtenues pour les taux d'exploitation des principales espèces démersales, la consultation attire l'attention du CGPM sur la gravité de la situation ainsi créée pour les stocks eux-mêmes et pour les pêcheries côtières que l'effort de pêche excessif conduit à menacer chaque jour davantage.

106. Compte tenu du fait que des raisons économiques sont en général avancées pour ne prendre aucune mesure positive, la consultation recommande que des études économiques complètes soient entreprises pour évaluer objectivement le coût actuel de la surpêche pour l'Etat et pour le consommateur, le manque à gagner créé par cette surpêche, et les risques économiques encourus à terme par tous les secteurs de la profession, y compris la pêche côtière.

107. - Régulation de l'âge de première capture:

Etant donné que dans certains pays de la sous-région les infractions systématiques à la loi, qui conduisent à une réduction du stock reproducteur rarement observée ailleurs dans le monde, sont la conséquence directe de la surpêche par un effort excessif, la consultation recommande que les mesures concernant le maillage soient considérées conjointement à des mesures de réduction de l'effort de pêche (même si ce n'est qu'à moyen terme) et à des mesures complémentaires visant à protéger dans le temps (fermetures saisonnières) et dans l'espace (cantonnements, récifs artificiels) les jeunes recrues.

108. - Harmonisation des législations:

Voir ci-dessus paragraphes 82 et 83.

109. - Point de vue de la Communauté économique européenne:

Le représentant de la Communauté économique européenne a tenu à réitérer l'intérêt profond de la CEE pour le développement rapide des connaissances sur les ressources de l'Adriatique et la mise en place de leur aménagement rationnel. Il a insisté sur le fait qu'après les efforts consentis par la CEE pour promouvoir les recherches, il était maintenant nécessaire d'accélérer l'analyse des travaux et d'arriver à des recommandations concrètes en matière d'aménagement.

IX. ORGANISATION DE LA PROCHAINE CONSULTATION

110. Le Laboratoire de biologie marine de Bari a offert d'accueillir la cinquième consultation. Cette invitation a été acceptée par acclamations. La consultation a estimé que cette réunion devrait se tenir en 1987, et la dix-huitième session du CGPM a été invitée à approuver cette proposition.

111. A ce propos les participants, tout comme le Secrétariat, se sont montrés préoccupés par l'évolution des réunions qui tendent à devenir des mini-congrès où des travaux individuels sont présentés et discutés, plutôt que des groupes de travail où des données sont analysées en commun et où les résultats sont approuvés par l'ensemble des chercheurs.

112. Il a été également reconnu que la quantité des documents présentés, de tenue scientifique inégale même si toujours d'un intérêt indéniable pour les discussions, étouffait le travail scientifique et l'élaboration d'une base scientifique commune acceptée par tous. En conséquence, il a été décidé:

- i) de rendre aux consultations leur caractère de groupe de travail;
- ii) d'envoyer au Secrétariat et à tous les participants annoncés, au moins un mois avant la réunion, tous les documents à présenter;
- iii) d'accepter cependant les documents apportés directement à la réunion à condition qu'ils soient remis pour distribution aux participants, dactylographiés et avec les figures et tableaux au propre, au moins 24 heures avant leur présentation;
- iv) d'effectuer un tri des publications et de ne conserver en annexe du rapport que les documents strictement scientifiques apportant des données et des résultats concrets. Les documents dits "de position" ne présentant que des points de vue ou des informations non quantifiées seront distribués et discutés mais ne feront pas systématiquement l'objet d'une publication.

113. La consultation a décidé que, lors de la préparation des ordres du jour et de la sélection des travaux à publier, priorité devrait être accordée aux domaines suivants:

- i) Travaux d'évaluation des stocks, et particulièrement ceux qui comportent des conclusions utiles pour l'aménagement.
- ii) Travaux réalisés en commun dans le cadre du programme "Etude des ressources biologiques de l'Adriatique en vue de leur exploitation optimale par un aménagement rationnel" défini par la première consultation (Split, 1980) et des directives adoptées lors des consultations successives.

114. La consultation a décidé en outre qu'une journée seulement, au début de sa prochaine réunion, serait consacrée à une présentation rapide des documents écrits (voir paragraphe 112 ii) et iii)) et que des groupes de travail - dans le cadre desquels les documents pertinents seraient discutés plus à fond - seraient mis sur pied pour traiter des questions essentielles figurant à l'ordre du jour, et en particulier de l'évaluation des ressources pélagiques et démersales.

115. Elle a enfin décidé que les thèmes retenus pour les groupes de travail lors de la cinquième consultation seraient:

- i) Stocks pélagiques: comparaison des évaluations réalisées par les méthodes analytiques et directes (acoustique, oeufs et larves);
- ii) Stocks démersaux: évaluation à long et à court termes des effets d'un changement du maillage.

X. ADOPTION DU RAPPORT

116. Le rapport de la quatrième consultation technique sur l'évaluation des stocks dans l'Adriatique a été adopté le 11 octobre 1985. A cette occasion les participants ont exprimé à l'Institut d'océanographie et des pêches de Split, et particulièrement à son Directeur M. Cetinić, leurs remerciements pour l'excellent accueil qui leur avait été réservé. Ils lui ont demandé de transmettre à M. S. Jukić, qui venait d'être victime d'un accident, leurs vœux de rapide et complet rétablissement.

I. INTRODUCTION

1. The Fourth Technical Consultation on Stock Assessment in the Adriatic took place in Split from 7 to 11 October 1985 at the kind invitation of the Yugoslav Government.
2. The Secretary of GFCM opened the meeting and thanked, on behalf of the Director-General of FAO, the local authorities and particularly Mr. Drago Urličić, the Director of the Institute of Oceanography and Fisheries for the work they had undertaken in organizing the meeting. The Secretary expressed his pleasure over the high number of participants and, particularly, over the fact that for the first time the four States concerned, Albania, Greece, Italy and Yugoslavia were all represented at the meeting.
3. Mr. Cetinić and Mr. Urličić then welcomed the participants and expressed their best wishes for the success of the meeting. They underlined the importance of this sub-regional meeting for the proper management of fishery resources in the Adriatic, which, in the case of Yugoslavia, played a very important role, particularly with regard to its economy.
4. The agenda given in Annex A was approved.
5. Mr. S. Jukić was elected Chairman of the Consultation and Messrs. C. Papaconstantinou and E. Kapidani were elected Vice-Chairmen.
6. The list of participants is given in Annex B.
7. The papers presented at the Consultation are listed in Annex C.

II. PROGRESS MADE IN THE ESTABLISHMENT OF A BIOLOGICAL DATA BASE

A. Descriptive Environmental Variables

8. Hydrographical Atlas ^{1/} The preparation of the Atlas and the Computerized Data Base had continued within the framework of Italo-Yugoslav cooperation, though insufficient resources had slowed progress in 1985. The Adriatic Data Base (A.D.B.) established in Italy now included over 8 300 stations and its structure was described (the simultaneously established Yugoslav Base included about 9 000). A statistical analysis of average (typical) values and their statistical accuracy had been carried out for the temperature data. Procedures to check and correct the data were also described. The informal group working in this area had grown to eleven members working in parallel with national teams following the mutual exchange of data (cf. paragraph 9, Report of the Third Consultation).
9. Methodological Procedure (cf. paragraph 9, Report of the Third Consultation): It had not yet been possible to develop a standardized procedure to collect environmental data. The constant need to calculate the confidence intervals of the parameters measured was recognized. It was also announced that a meeting would be held in Italy in December 1985 to develop standard procedure forms. Finally it was underlined that the calibration of precision measuring instruments was causing considerable problems. The Third Consultation recommendation was reiterated (cf. para 13, Report of the Third Consultation).
10. Long-Term Time Series: Time series to study interannual climatic variations in the Adriatic had not yet been produced for the meeting. A request was made to supply references for those already published in specialist papers. It was also pointed out that it would be useful for biologists to have access not only to the raw data but also to an analysis of recurring variations, for these are likely to reappear in fundamental biological phenomena such as recruitment.

^{1/} See Annexes D and E, and Annex C, document 26

11. A number of points arose during the discussion which followed the presentation:

- biologists need a description of "standard" geographic and seasonal situations as well as an identification of climatic anomalies. Similarly they need to know the time series and the anomaly years;
- some physicists expressed the need for a statistician to develop the data base;
- the importance of the thermohaline fronts observed in the North Adriatic.

B. Atlas of the Fisheries of the Western and Central Mediterranean

12. After a brief summary of the objectives and background of the Atlas it was stated that pelagic breeding grounds should be reviewed as detailed information was now available which would considerably improve the data provided in the Atlas. S. Regner agreed to prepare a preliminary draft which will be included as an appendix of the report of this meeting and kept for later use during the preparation of the subsequent version of the Atlas*.

13. It was also emphasized that the present Atlas was only a preliminary version which everybody could use as a working document, with a view to its gradual improvement.

C. Atlas of Adriatic Stocks

(cf. paragraph 15, Report of the Third Consultation)

14. It had not yet been possible to prepare this detailed Atlas, which had been mentioned during the previous session.

D. Summary of Biological Parameters

15. A number of papers presented to the Consultation contain recently estimated biological parameters, which are summarized in Table 1 for easy reference.

Species	K	l_{∞}	t_0	Z	$W = aL^b$
<u>Merluccius merluccius</u> (H)	0.070	64.2		0.85-1.37	$a = 6 - 12 \times 10^{-6}$ $b = 3.00 - 3.16$
<u>Merluccius merluccius</u> (J)				0.72	
<u>Mullus barbatus</u> (I)				1.45-1.64	
<u>Solea vulgaris</u> ♂ (P)	0.069	23.2	-1.66		$a = 1.56 - 1.82$ $b = 2.87 - 2.88$
<u>Solea vulgaris</u> ♀	0.042	37.9	-5.36		
<u>Solea vulgaris</u> ♂	0.041	38.2	-3.57		
<u>Engraulis encrasicolus</u> (T)					

Note: Letters in brackets refer to the annex from which data are taken.

* This draft was not received by the Secretariat

III. PROGRESS IN FISHERY STATISTICS

16. Italy: The objectives of the PESTAT programme were summarized. The final report of the fleet inventory had been published. Following a query from the EEC representative it was stated that the second part of the work involving an assessment of catch and effort was near completion and the results would be available at the beginning of 1986. The new forms prepared by ISTAT ^{2/} for the registration of vessels and their characteristics would henceforth enable the registry of the Italian fleet to be updated more efficiently. In answer to a further query from the EEC representative it was confirmed that the new procedures should improve the reliability of Italian fleet statistics considerably, though continuous efforts would still have to be made to ensure effective technical monitoring of the new system.

17. Yugoslavia: The problems which had arisen within the Department of Statistics in Zagreb, mentioned during the previous session, remain unresolved. There are still no official data on catch and effort statistics regarding the small-scale sector or privately-owned vessels (see paragraph 98).

18. Small-scale Fishery: In line with GFCM recommendations the agenda laid great emphasis on small-scale and lagoon fisheries. However the small number of papers on this subject discouraged discussion of the problems involved.

19. Small-scale Italian fishery was described ^{3/}, illustrating the different fishing practices in the Adriatic. In the Northern Adriatic hydraulic dredges (for bivalves) and gillnets (for plaice and cuttlefish) were used whereas in the Central Adriatic greater use was made of pots. Southern Adriatic fishing also relied more on fixed gear and long-lines for swordfish and tuna. Catch and effort data, also provided, were taken partly from the PESTAT programme and partly from special surveys by the IRPEM in Ancona.

20. It was once again stressed that in the Northern Adriatic heavy tonnage trawlers (up to 40 h.p.) operating in the coastal area were making the situation impossible for small-scale fishing.

IV. STATE OF DEMERSAL STOCKS

21. Though the fishery statistics situation on both shores of the Adriatic was still worrying, considerable progress had been made thanks to the data collected during the scientific trawl cruises.

A. Updating of Catch and Effort Data

22. No information on this matter was made available to the Consultation.

B. Production Models

23. A multispecies production model was presented ^{4/}. This model, whereby Fox's model is applied to 12 species from the Yugoslavian Adriatic, employs non-linear programming to solve simultaneously Fox's 12 equations for the 12 species. The author described the "optimum" as being the fishery effort needed for the largest catch possible without any of the 12 stocks being heavily overfished. When applied to Yugoslav resources (with the only catch and effort data available for the country) the author can determine the optimal catch levels per stock and is able to demonstrate that the average effort in recent years has been excessive (in relation to the criterion considered optimal by the author).

24. The practical impact of this analysis, however, would be considerably restricted if stock abundance variations (downward) in the Yugoslavian catch were due more to the Italian effort variations (by far the more important) than to those of Yugoslavia.

^{2/} See Annex F

^{3/} See Annex G

^{4/} See Annex C, document 17

C. Other Assessments

25. Highly interesting new results had been produced by the scientific trawl cruises.

Merluccius merluccius in the Northern and Central Adriatic ^{5/}

26. The paper presented showed that the stock was heavily overfished. Most total mortality figures hovered around $Z = 1/\text{year}$. As the natural mortality of this species was about $M = 0.2 - 0.3$, $F = 0.7 - 0.8/\text{year}$ was 2.5 to 4 times the value of M . The exploitation rate would be $E = F/Z = 0.75$ approx. The size at first capture depends on depth, season, etc. However the young in each cohort are primarily taken from the nurseries (towards 200 m depth) with a size of 8 cm (total length). Given this size, the paper showed that there would be substantial gain, in weight and value, if lc could be increased or F reduced.

27. It was emphasized that the excessively small size of the fish caught was a consequence and not the prime cause of overfishing, which was due to excessive effort. Any strategy to protect the young (i.e. to counteract the impact of overfishing) without a reduction in effort (i.e. without tackling the heart of the problem) was doomed to failure and would have to cope with very high-cost control and monitoring to enforce an economically hard-to-enforce measure.

Merluccius merluccius in the Southern Adriatic

28. A brief paper ^{6/} presented the results obtained for hake offshore in the Southern Adriatic. It was interesting to note that the size composition observed (and consequently total and fishing mortality) were very similar, which confirmed the fact that the fishing pressure in the South approximated the pressure in the North, which had been analyzed in greater detail (see paragraph 26).

Mullus barbatus in the Northern and Central Adriatic ^{7/}

29. Similar studies carried out for this species had produced estimates of $Z = 1$ to 2 per year with an average of $Z = 1.6$. In addition, Z values for the 0 group appeared as high as $Z = 2$ to 4 per year. Though these values should be considered with caution, they would seem to confirm the very high juvenile mortality of this species in summer and autumn along the Italian coast. Accepting a tentative value of $M \approx 0.4/\text{year}$ for this species, exploitation rate would be $E = F/Z$ of 0.75, similar to the figure for hake and again indicating severe overfishing. The high Z values for juveniles, if confirmed, would be a further proof of what we already knew, namely that the very young were extremely vulnerable and under excessive fishing pressure.

30. The problem of apparent major recruitment variations was discussed. As the fishing effort was fairly stable, the solution would be to determine mean size (and age) distributions for several years as and when the data base improves, then calculate average Z values from these data.

31. The problem of the respective contributions of Italian and Yugoslav nurseries to the recruitment of Mullus barbatus common stock was briefly discussed. As the normal bio-coenoses of red mullet nurseries were virtually exclusively on the Italian coast it could be tentatively assumed that the overwhelming majority of recruits come from Italy. It was furthermore stressed that it was very unusual to find concentrations of small red mullet in the Yugoslav channels.

32. Finally it was stated that the age of mullet at first capture in Yugoslavia was far above that normally found in Italy.

Merluccius merluccius in Greek Coastal Areas ^{8/}

33. A survey in the Patraikos and Korinthiakos Gulfs and the Ionian Sea, similar to that undertaken in the Northern Adriatic, based on experimental trawl surveys demonstrated that with total mortality levels of $Z = 0.72$, and fishing mortality levels of $F = 0.53$, stocks were very heavily overfished ($E = 0.74$).

^{5/} See Annex H

^{6/} See Annex AA

^{7/} See Annex I

^{8/} See Annex J

Mullus barbatus in Greek Coastal Areas 9/

34. A similar study carried out in the same area produced values of $Z = 0.68$, $F = 0.51$ and $E = F/Z = 0.73$.

35. It was clear that there was also an excessive exploitation of traditional resources in this area, just as in the Adriatic where similar values were obtained.

Chlamys opercularis and Pecten jacobaeus (Adriatic) 10/

36. The paper presented reported on an important potential resource of Chlamys opercularis in northern Adriatic. This stock was presently little fished in the southern part of its distribution area though it was well known to fishermen and should be examined more closely. The market seemed, for the time being, to be the limiting factor.

37. This study of a lightly fished stock was of considerable interest, though the impact of the fishery, whether direct (in areas where the species were exploited) or indirect (intensive trawl fishery causing mortality from shell breakage should be examined.

Associated Species 11/

38. A brief preliminary note was presented concerning the seasonal cpue variations of non commercial species in the Gulfs of Patraikos and Korinthiakos and in the Ionian Sea.

D. Matters Related to Trawl Surveys

Catchability Variations 12/

39. A detailed study of nycthemeral catchability variations was carried out. Such a study is timely in that it provides valuable data on sources of variability affecting the trawl survey data. It can be seen that these variations are significant and can bias results, blunting accuracy if not taken into account in survey programmes and/or when stratifying the data for statistical processing.

40. It was stressed that a study on all demersal stocks should include both day and night trawls to avoid consistent bias of abundance assessments of certain species.

Chamelea gallina (Small Hard Clam)

13/

41. A preliminary paper was presented. It provided a preliminary assessment of the minimum biomasses measured in 1984 by scientific surveys using a hydraulic dredge between Monfalcone and Caorle and between Goro and Barletta. The densities observed varied from 2 to 52 kg/1 000 m². These results are considered highly tentative.

Survey Methods

42. A discussion was held on appropriate methods of assessing stock, referring to the initial report "Statistical considerations in the design of trawl surveys" prepared by Mr. Fogarty (FAO Fish.Circ., 786, 1985) following the workshops held in Fano and Mazara del Vallo in 1984. The discussion centered once again on the problem of sampling programmes and, in particular on the respective advantages and disadvantages of systematic and random stratified programmes. 14/ Diametrically opposed opinions of the two methods were expressed.

43. The Technical Secretary reminded the Consultation that the problem was one of methodology which was not based on "opinion" but rather on quantitative analysis based on time-tested methods. He reminded the participants that the Fano and Mazara workshops had been held to cut short unproductive discussion and to determine an objective basis for a

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- 9/ See Annex K
10/ See Annex L
11/ See Annex M
12/ See Annex N
13/ See Annex O
14/ See Annex C, document 25

choice of methods which would satisfy scientific conditions and enable survey objectives to be attained. Each should therefore draw his own conclusions and the scientific community should judge the results acquired. The Secretary merely wished to remind the Consultation that it was essential for estimates to be accompanied by their confidence intervals and that such calculations were not yet possible by means of strictly systematic sampling. The manuals currently available were categorical on this point.

Age Reading on Flatfish (Pleuronectiforms) 15/

44. It was shown that with regard to a number of flatfish species in the Adriatic, the development of the otolith hyaline and opaque zones was in complete contrast to the theory. In the case of the *Solea vulgaris* and certain other species, the hyaline zone would appear to be deposited during the warm season and the opaque zone during the cold season, contrary to general belief. The resulting assumption is that the establishment of these zones is associated with spawning and not with growth and temperature. The growth parameters (K , L_{∞}) do not appear to be affected, but absolute ages (and t_0) are shifted by six months if this phenomenon is not taken into account.

V. PELAGIC RESOURCES

A. Updating Catch and Effort Data

45. The data made available to the Consultation is provided in Table 2 below.

Table 2 - Total sardine, sprat and anchovy catches from 1981 to 1984 (tons)

Year	Sardine		Sprat		Anchovy	
	Yugoslavia	Italy	Yugoslavia	Italy	Yugoslavia	Italy
1981	31483	41 698*	2637		2284	18 647*
1982	25728	36 592*	3822		2326	22 420*
1983	40044	33 182*	1895		945	18 300*
1984	35623	25 421**	1168		1342	13 179**

* Ports of Trieste, Chioggia, Porto Caribaldi, Cesenatico, Cattolica and Ancona.

** Above ports plus San Benedetto del Tronto and Vieste.

In addition, 22 997 tons of sardine and sprat were sent to fish meal factories in 1984. All Italian figures were collected by IRPEM, Ancona.

Development of the Yugoslav Fleet 16 /

46. The Yugoslav fleet had been modernized by introducing pair-trawling pelagic vessels with apparently excellent results. The purse-seiners, which were presently in very poor shape would be renovated and the pelagic trawler fleet further developed by extending the fishing zone around the Dalmatian Islands and off-shore.

Relationship Between cpue and Abundance for Sardines 17/

47. An analysis of the statistical distribution of yields was presented. Daily yield distributions were log-normal due to the way sardines concentrate. The dissymmetry index (the mean/variance ratio) varied over time (declining since 1979) from north to south, and according to the season. There was a good correlation between cpue and the dissymmetry index of distributions.

B. Biological Data

Stock Identification

48. This was a fundamental problem for management. Interesting data concerning the sardine had been collected and brought to the Consultation's attention 18/.

15/ See Annex P

16/ See Annex Q

17/ See Annex R

18/ See Annex S

49. The summary of data available on this matter indicated a strong likelihood that the eastern Adriatic stock was composed of two separate sub-populations corresponding to distinct spawning grounds.

Sardine and Anchovy Spawning Areas 19/

50. Additional data on pelagic breeding had been collected through cruises which, for the first time, covered all the Italian Adriatic and, in particular, the area south of the Gargano. These cruises had confirmed the fact that the main anchovy spawning area lay in the Northern Adriatic. Intensive sardine breeding areas were observed both in the central Adriatic and in the southern Adriatic below Gargano. There appeared to be a continuity between the two main spawning areas of the northern and southern Adriatic which suggested the need for global coverage of the Adriatic to estimate pelagic stock.

51. During a discussion on the chances of anchovy winter breeding it was stressed that, except in rare cases, the breeding of this species, measured by the presence of eggs, was restricted to the spring-summer period.

52. Two brief papers were also presented concerning the biometric relationships of the sardine 20/ and the aggregation composition of sardine schools in Adriatic waters 21/. Again the distribution of school size appeared to be log-normal. The principal features of these schools have been described.

C. Direct Estimates of the Biomass

53. The progress made at the IRPEM in Ancona on the identification of small pelagic fish schools was reported. Results obtained from 1978 to 1982 indicated a predominance change after 1981. Where the anchovy had been dominant before 1981, in 1981 and 1982 it was replaced by the sardine. These findings acquired by analyzing acoustic survey data were supported by data gathered during landings which indicated the same reversal at the market level.

54. It was stated during the discussion that the apparent variations, which could correspond to north-south movements in the respective sardine and anchovy stock concentration areas, were more likely to be caused by environmentally-determined recruitment and biomass fluctuations.

D. Protection of Juvenile Stock in the Adriatic 22/

55. The paper presented underlined the existence of sardine nurseries in the Bays of Karin and Novigrad and the interannual variations in juvenile abundance in these nurseries, where catch levels were sometimes high, even in sizes below the legal minimum.

56. It was pointed out that these bays were only part of the nursery area available along the Italian and Yugoslav coasts and that the variations observed did not necessarily reflect global recruitment variations in the Adriatic. It was however agreed that this hypothesis should be tested and studies are now in progress.

57. The discussion then centered on the protection of the juveniles with reference being made to the "bianchetto" in Italy and pelagic post-larval fishing in Spain, which had recently been strictly banned by the Spanish authorities because of the damage done by this fishery. It was emphasized that the fishing permit mentioned in appendix 23 was temporary (two years) and restricted to this traditional fishing ground under the supervision of the Split Institute.

E. Estimates of Pelagic Abundance by Eggs and Larvae 23/

58. Summaries of the work undertaken in the laboratories of Split, Fano and Trieste were presented, together with a statistical analysis of the results obtained since 1976

<u>19/</u>	See Annex T
<u>20/</u>	See Annex U
<u>21/</u>	See Annex V
<u>22/</u>	See Annex W
<u>23/</u>	See Annex X

(values of the anchovy biomass and confidence intervals). Long-term variations came to light which more or less confirmed the variations indicated by the acoustic surveys. Such confirmation perhaps indicated that the two methods had attained the requisite level of maturity and could suggest that a fruitful comparison of findings would soon be possible. An average abundance stratification was developed which would be used in the future to establish survey programmes.

59. Following the report it was stressed that further progress was needed and that more detailed research would be undertaken for a better understanding of the real level of sardine and anchovy fecundity and of annual spawning frequency.

60. Furthermore it is now clear that the number of stations per cruise should be reduced whereas the number of cruises should be increased for a better coverage of the spawning period and scheduling of cruises within this period.

VI. SPECIAL PROBLEMS

A. Coastal Fisheries

61. Following GFCM recommendations on this matter the Consultation focussed more attention on coastal fisheries.

62. Italy: The paper presented ^{24/} considered the whole 12 miles zone as a coastal fishing area. It specified the different species to be found and the methods of fishing employed. The paper stressed that most of the Italian fishing effort was concentrated within the Italian 12 mile limit and this was where most of the biomass caught came from. It also stressed that Italian regulations were rarely or never enforced.

63. The paper proposed an experimental closed season during the recruitment period, banning fishing successively within the 6 mile zone for six weeks in August/September and for six more weeks within the six to twelve mile zone in October/November. This proposal was based both on the positive results observed in Cyprus over the past years following the implementation of similar measures and on the biological data collected in the Italian coastal area.

64. A fundamental objection was raised during the discussion, namely that should the experiment be successful the considerably increased profitability, which one could expect, might, as in Cyprus, lead to an increased fishing effort which would cancel the advantages gained. Therefore, without a clear policy from the outset which actually limited the fishing effort, such an experiment would not offer any viable solution to the current problems.

65. It was felt that were funds to be made available for such an operation they should preferably be used for measures to reduce the effort in the coastal area.

66. Finally it was thought that, in any case, such an experiment should take place in small semi-closed areas (virtually independent small bays) to increase the chances of successfully proving, at low cost, the effectiveness of these measures.

67. The discussion also covered the problem of management and development interaction. It was stressed that without clear common objectives and coordination of policies, both at the national and European level, development agency efforts would only serve to stimulate the unrestrained fishing effort increase through their ill-considered aid programmes. Some participants in particular felt this to be the case regarding requests made to the EEC to finance Italian fishing.

^{24/} See Annex Y

68. Yugoslavia: A synopsis ^{25/} was presented summarizing data on experimental catches made from 1971 to 1984 using the bottom trammelnet. It analyzed yield and species composition variations in the different areas. It showed a long-term drop in yields and a change in species composition characteristic of overfishing and perhaps pollution.

B. Economic Studies

69. Two papers on this topic were presented covering a preliminary bioeconomic study of the problem of changing the mesh size and the shift to a 40 mm mesh in Yugoslavia and Italy. The two studies, which were discussed at length, drew fairly similar conclusions.

70. The paper ^{26/} showed that in Yugoslavia, a 40 mm mesh size would be too small for many of the main species (Pagellus, Merluccius, Nephrops) and that 55 mm, or even 65 mm would be biologically preferable. The paper acknowledged that though the long-term consequences would be beneficial, the short-term losses would be too high.

71. This confirmed all the previous findings of the various GFCM working groups, which had always indicated that for many species the proposed 40 mm mesh size was only a minimum and represented a first step towards a mesh size better suited to Mediterranean conditions.

72. In Italy the work presented ^{27/} also indicated that a mesh size greater than 40 mm would be biologically preferable but that a generally enforced 40 mm mesh size would have the following consequences:

- a biomass shift out to sea and coastal area loss,
- advantages primarily for the deep-sea fleet (fishing outside the six mile limit).

73. The Consultation however noted that, if it is easy to evaluate the short term consequences, the long term consequences should be treated through the employment of long-established scientific procedures for such an analysis (Gulland, Jones, Cadima, yield per recruit, etc.). The analysis of long-term gains should be thoroughly studied. Data regarding the real size composition of commercial catches (total annual distribution of size frequencies) are basic to this kind of study.

74. Having, for a number of years, agreed to the 1976 GFCM Recommendation XIII/76/1 on the 40 mm mesh size, Italy, as a Council member should enforce it. The two-year grace period granted by the Italian authorities had expired, as had the three phase procedure recommended by the GFCM in 1980, which ended on 1 October 1983, so Italy should enforce this mesh size, as should the other GFCM Member States.

75. It was acknowledged the coastal fishing was indeed a problem. It was suggested, however, that it should be handled separately, at a later date, from the standpoint of options available to this fishery (artificial barriers, inshore aquaculture, alternative usages, etc) within the framework of the inevitable overall reduction in fishing effort under present conditions.

76. Finally, it was accepted that the 50 or 60 mm mesh size was in fact the only measure likely to improve the state of certain stocks for deep-water fisheries.

77. In a more general vein, it was stressed that scientific work on such an important management problem as mesh size should provide a complete picture of the problem (short-term losses and long-term gains). This would avoid erroneous advice, which did not consider all the possible options and all their foreseeable consequences, being given to the authorities.

^{25/} See Annex Z

^{26/} See Annex C, document 19

^{27/} See Annex C, document 11

78. It was also stated that the Cyprus example should remain foremost in scientists' minds, to clearly illustrate that, under conditions of severe overfishing, the classical models greatly underestimated the real consequences of effective protection of the juveniles.

C. Research Coordination

79. The need for research coordination was again strongly underlined recognizing that a great deal still remained to be done. Two concrete steps were put forward which the consultation fully supported.

80. Acoustic Methods: In October-November 1986 the Ancona Institute will organize a practical training course providing experience in acoustic survey techniques and equipment utilization. Adriatic scientists working in this field will be invited, especially those from Greece and Albania, who have only just begun to employ such techniques. Mr. Azzali will be the course coordinator.

81. Comparison of Pelagic Assessment Methods: The current level of experience in direct assessment methods (eggs and larvae or acoustic) and indirect methods (analytic) warranted the convening of a meeting to compare the results obtained. Such a meeting had, moreover, been recommended by the FAO Advisory Committee on Marine Resources Research (ACMRR). The Ancona Institute volunteered to host this meeting in 1987.

VII. HARMONIZATION OF LEGISLATION

82. One paper presented ^{28/} again raised the problem of harmonizing all legislation of countries exploiting a common stock and who sooner or later would have to manage this stock in close collaboration.

83. Having again acknowledged and confirmed that a number of the more valuable stocks were resources of common interest requiring common management, the Consultation agreed that progress on this matter should be made. The Consultation recommended that legal experts from the countries concerned should meet in the near future, to establish a basis for the harmonization of legal texts with a view to joint resource management. The GFCM Committee on Resource Management was asked to place this item on the agenda of its next meeting.

VIII. GUIDELINES AND RECOMMENDATIONS

84. The Consultation examined the follow-up to the guidelines of the previous Consultation, the work undertaken during the intersession and the guidelines for work to be carried out before the next meeting.

A. Research

i) Demersal Stocks

85. - Use the trawl cruise data to complete the species distribution maps:

This guideline had been partially followed. Further work would have to be undertaken and the best stratifications possible should be determined. The possibility of stratification by fish community should be looked into.

86. - Calculate the mortality rates from size frequencies

This guideline had been followed during the intersession: It should however continue to be followed on a regular basis to better assess the accuracy of the values obtained and compensate for recruitment variations from one year to the other by applying the mean value.

^{28/} See Annex C, document 30

87. - Fitting von Bertalanffy's growth curves

This guideline had been followed during the intersession. It should be implemented as a matter of course. Age validation studies should be pursued more fully. K and L confidence ellipses should be regularly calculated to facilitate comparisons (the methodology will be supplied by the Secretariat).

88. - Study the age and size geographical distribution to investigate migrations

This guideline had been followed for red mullet and sardine. It should be regularly followed for the other species.

89. - Analyse the length data for the "Hvar" cruise catches

This guideline had not been followed and should be as soon as possible.

90. - Experimental trawl surveys

Main species density calculations, for the whole of the Adriatic, together with characteristic strata calculations (slope, nurseries, etc.) should be regularly made. Coverage of the Adriatic should be as complete as possible. The confidence intervals of assessments made should be regularly calculated using the appropriate methods.

91. - Biological sampling of catches and/or landings

This guideline is difficult to follow and in fact had not been followed. Efforts should be made to take a minimum sampling during the recruitment period to determine age and size at first capture. Similarly a sampling of commercial catches during the trawl survey should be taken to determine the shape of the F vector per size class 29.

ii) Pelagic Stocks

92. - Definition of stock units

This guideline had been followed for sardine. The Consultation, however, called for the continuing collection of evidence for or against the separation into two sub-populations and asked for a clear distinction to be made regarding the problem of egg concentration separation and that of adult separation. It also mentioned the need to look into the problems of mixing and north-south migration. An analysis of the meristic data would have to be resumed.

93. - A cost-benefit study of Yugoslav pelagic fisheries

This would have to be prepared.

94. - Closer examination of small pelagic fish fecundity and annual spawning frequency is needed.

95. - Comparison of assessment methods

The Consultation accepted the IRPEM proposal to hold a workshop in Ancona to compare the results obtained from the different methods of pelagic fish assessment. It hoped the Secretariat would take part and provide its technical support.

96. - Hydrology/Climatology

An annotated bibliography of publications and papers containing the time series needed to analyse long-term variations will be prepared.

B. Statistics

97. The Consultation considered the following steps essential:

98. Obtaining reliable statistics on landings and fleet composition by size for each country in the sub-region and, in Yugoslavia, collecting data on small-scale coastal fishing and private fishing.

99. Making the PESTAT II findings available to all the participants as soon as possible.

C. Sub-regional Collaboration 30/

100. Already existing collaboration should be pursued in the following areas:

- (a) biomass assessment cruises using the eggs and larvae methods,
- (b) scientific trawl cruises,
- (c) acoustic survey cruises.

101. Joint survey cruises were suggested to enhance collaboration on the latter given the absolute need to cover as much of the total pelagic stock distribution area as possible. Teams of scientists from all the states involved would work on one vessel. It was recognized that official contacts would have to be made sufficiently in advance by the IRPEM in Ancona to obtain the necessary authorizations.

102. - Demonstration Course:

The Consultation appreciated the IRPEM proposal to hold a demonstration course in 1986 in Ancona on the utilization of acoustic equipment (theory, equipment, data processing techniques, etc.).

103. - Development of a hydrological data base:

The Consultation again acknowledged the importance of producing an Atlas and a hydrological Data Base for research into resources and their management and underlined the importance of closer collaboration between the laboratories involved. If the Consultation's objectives are to be achieved, regular contact is needed between scientists to resolve the numerous technical problems which are still hampering progress. The Consultation therefore urged that efforts be made on all sides to facilitate the organization of Atlas and Data Base workshops. Financial assistance would be sought from FAO, the IOC and Unesco.

104. - Joint study programme on small pelagic fish:

Referring to a collaboration proposal from the IRPEM in Ancona for a joint study on small pelagics, a common resource throughout the sub-region, the Consultation acknowledged that the following would be essential:

- catch and effort data to be collected by a thorough investigation, by vessel and covering the whole fleet;
- data to be collected, with the maximum possible coverage of the private sector (in Yugoslavia), if necessary using a stratified sampling programme per area and port;
- length sampling to be undertaken twice a month with a sampling for age reading and the identification of meristic features on the basis of 10 individuals per 1 cm. length class and per port.

The above list is indicative. Contact will be made at a later date between the scientists involved to decide on the details of the relevant programme (sampling frequency, organization of the data base, etc.).

D. Management

105. Control of the fishing effort

With the trawl survey results in mind and considering the consistent and extremely high figures for the exploitation rate of the main demersal species, the Consultation wished to bring to the attention of the GFCM the seriousness of the situation for the stocks themselves and for coastal fisheries, which the excessive fishing effort is increasingly threatening every day.

106. Given that the absence of positive measures is generally defended on economic grounds, the Consultation recommends that thorough economic studies be carried out to assess the current cost of overfishing objectively, both to the State and to the consumer; to evaluate the economic losses deriving from this overfishing and to determine the eventual economic risks for all sectors of the fishing industry including coastal fishing.

107. Control of age at first capture

Given that the law is regularly infringed in some of the sub-region states, causing a level of spawning stock reduction rarely seen elsewhere in the world and that this is a direct consequence of overfishing through excessive effort, the Consultation recommends that measures regarding mesh size be considered jointly with measures to reduce the fishing effort (even if only in the medium term) and complementary measures to protect the young recruits at specific times (seasonal closures) and places (confined areas, artificial reefs).

108. Harmonization of legislation

See paragraphs 82 and 83 above.

109. Views of the European Economic Community

The European Economic Community representative wished to reaffirm the strong interest of the EEC in a rapid development of expertise on Adriatic resources and in the establishment of rational management. He stressed that, following the efforts by the EEC to encourage research, there was now a need to hasten the analysis of the finished work and to put forth concrete recommendations on resource management.

IX. ORGANIZATION OF THE NEXT CONSULTATION

110. The Marine Biology Laboratory of Bari offered to host the Fifth Consultation. This was readily accepted. The Consultation felt that this meeting should be held in 1987 and the eighteenth session of the GFCM was asked to approve this proposal.

111. On this subject both the participants and the Secretariat expressed concern over the way meetings were tending to become mini-conferences, where individual work was presented and discussed, rather than working groups, where data were jointly analyzed by participants and the findings approved by all scientists attending.

112. It was also acknowledged that the number of papers presented (some with more scientific content than others, though all undeniably of interest for discussion) tended to overwhelm the scientific work and the development of a common scientific base acceptable to all. It was therefore decided:

- i) that the Consultations would in future resume operating as a working party;
- ii) that all the papers to be presented should be sent, at least one month prior to the meeting, to the Secretariat and all expected participants;
- iii) that, however, papers brought directly to the meeting would be accepted on condition that they were distributed to the participants at least 24 hours before their presentation, and that they were typed with neatly presented figures and tables;

- iv) that a selection of publications should be made and that only papers which were strictly scientific and which provided data and concrete findings should be included in the report annexes. So called "position" papers and which contained only opinions or unquantified information would be distributed and discussed but would not necessarily be published.

113. The Consultation decided that the agenda and the selection of papers for publication would be based on the following priorities:

- i) work on stock assessment, particularly work which provided conclusions useful for development;
- ii) joint undertakings which fell within the framework of the programme, "The Study of Adriatic Biological Resources with a View to their Optimum Exploitation through Rational Management", as defined by the first Consultation (Split, 1980) and guidelines adopted during the successive consultations.

114. The Consultation also decided that only one day at its next meeting would be devoted to a quick presentation of written papers (see paragraph 112 ii) and iii)) and that working parties - where the relevant papers would be discussed in greater depth - would be set up to examine the essential issues on the agenda and, particularly, the assessment of pelagic and demersal resources.

115. Finally the Consultation decided that the fifth consultation working groups would look into:

- i) Pelagic stocks: a comparison of assessments made by analytic and direct methods (acoustic, eggs and larvae);
- ii) Demersal stocks: a long and short term assessment of mesh size modification consequences.

X. ADOPTION OF THE REPORT

116. The report of the Fourth Technical Consultation on Stock Assessment in the Adriatic was adopted on 11 October 1985. The participants wished to thank the Institute of Oceanography and Fisheries in Split and in particular the Director, Mr. Cetinić, for the very warm welcome they had received. He was asked to pass on their wishes for a rapid and complete recovery to Mr. S. Jukić, who had been injured in an accident.

ANNEXE A

ORDRE DU JOUR

1. Ouverture de la Consultation
2. Adoption de l'ordre du jour
3. Election du Président et du vice-Président
4. Progrès réalisés en vue de la constitution d'une base de données biologiques
 - 4.1 Eléments descriptifs du milieu
 - Atlas hydrologique
 - Méthodologie normalisée
 - Séries temporelles de paramètres climatiques
 - 4.2 Cartes des peuplements ichtyologiques. Présentation de l'Atlas des pêcheries de la Méditerranée occidentale et centrale, et commentaires
 - 4.3 Résumé des paramètres biologiques et préparation de nouveaux synopsis sur les espèces
 - 4.4 Problèmes relatifs aux populations d'alevins de poissons
 - 4.5 Problèmes relatifs à la lecture de l'âge
5. Progrès réalisés lors de la collecte des statistiques de pêche
 - 5.1 Résultats pratiques de PESTAT
 - 5.2 Problèmes de la petite pêche
 - 5.3 Problèmes posés par les données sur les pêches lagunaires
6. Etat des stocks démersaux
 - 6.1 Mise à jour des statistiques de capture et d'effort (voir également l'Atlas, sous 4.2)
 - 6.2 Modèles de production; revue rapide des travaux et des progrès réalisés. Présentation de l'analyse yougoslave, des données utilisées et des conclusions
 - 6.3 Prospections par chalutage
 - Etude du rapport Fogarty. Travaux réalisés depuis l'Atelier de Fano sur la méthodologie des prospections par chalutage, juillet 1984
 - Analyse des distributions globales (regroupées) des fréquences de taille
 - 6.4 Analyse des rendements par recrue
 - 6.5 Conclusions et recommandations
7. Etat des stocks pélagiques
 - 7.1 Mise à jour des données de capture et d'effort (voir également l'Atlas, sous 4.2)
 - 7.2 Progrès réalisés sur les modèles de production
 - 7.3 Estimations directes de la biomasse
 - 7.4 Conclusions et recommandations

8. Problèmes particuliers

- 8.1 Pêcheries côtières. Evaluation de la mortalité par pêche sur les très jeunes poissons
- 8.2 Etudes socio-économiques. Rapport sur les travaux réalisés au cours de l'intersession
- 8.3 Coordination des unités de recherche. Rapport de situation
- 8.4 Coordination des campagnes

9. Progrès réalisés en vue de l'harmonisation des législations

10. Recommandations relatives aux programmes de recherche et d'aménagement jusqu'à la prochaine consultation

11. Autres questions

12. Date et lieu de la prochaine consultation

13. Adoption du rapport

APPENDIX A

AGENDA

1. Opening of the Consultation
2. Adoption of the Agenda
3. Election of Chairman and Vice-Chairman
4. Progress made in the establishment of a biological data base
 - 4.1 Elements describing the environment
 - Hydrological atlas
 - Standard methodology
 - Time series of climatic parameters
 - 4.2 Maps of fish populations. Presentation of and comments on the Atlas of the Fisheries of the Western and Central Mediterranean
 - 4.3 Summary of biological parameters and preparation of new species synopsis
 - 4.4 Problems of fish fry populations
 - 4.5 Age reading problems
5. Progress in fishery statistics collection
 - 5.1 Practical results of PESTAT
 - 5.2 Problems of small-scale fisheries
 - 5.3 Problems of lagoon fisheries data
6. State of demersal stocks
 - 6.1 Updating of catch and effort statistics (see also the Atlas, under 4.2)
 - 6.2 Production models; brief review of work and progress accomplished. Communication of the Yugoslav analysis with data used and conclusions
 - 6.3 Trawl surveys
 - Review of Fogarty's report. Work accomplished since the Fano workshop on trawl survey methodology, in July 1984
 - Analysis on overall (pooled) size frequency distributions
 - 6.4 Yield per recruit analysis
 - 6.5 Conclusions and recommendations
7. State of pelagic stocks
 - 7.1 Updating of catch and effort data (see also the Atlas, under 4.2)
 - 7.2 Progress on production models
 - 7.3 Direct estimates of biomass
 - 7.4 Conclusions and recommendations

8. Special problems
 - 8.1 Coastal fisheries. Assessment of fishing mortality on very young fish
 - 8.2 Socio-economic studies. Report on work achieved during the intersession
 - 8.3 Coordination of research units. Progress report
 - 8.4 Coordination of cruises
9. Progress made in harmonization of legislations
10. Recommendations on research and management programmes until the next consultation
11. Any other matters
12. Date and place of next consultation
13. Adoption of the report

ANNEX(E) B

Liste des participants/List of participants

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ANNEX(E) C

Documents présentés à la consultation/Documents presented to the Consultation

1. Alegria-Hernández, V., Catch per unit effort as an index of sardine (Sardina pilchardus Walb.) distribution changes along the eastern Adriatic.
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16. Giovanardi, O., M. Rizzoli, S. Jukić, Preliminary considerations on the fisheries management of the hake (Merluccius merluccius L.) stock in the Adriatic sea.
17. Granić, B., The problem of optimization of the exploitation of demersal resources.
18. Jardas, I., Trammel bottom set catches along the eastern Adriatic coast (1971-1984).
19. Jukić, S., C. Piccinetti, Biologic and economic aspects on management of the multi-species demersal resources by regulation of cod-end mesh size.
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23. Papaconstantinou, C., K. Stergiou, G. Petrakis, Abundance of non-commercial fish in the Patraikos and Korinthiakos gulfs and the Ionian see, Greece.
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ANNEX (E) D

Italian advances in hydrological data base for the Adriatic Sea

by

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Abstract

The Adriatic Data Base project was born under the GFCM recommendation, Ancona 1982, as an Italo-Yugoslavian program, able to show, through an analysis of Adriatic historical data, the mean seasonal oceanographical conditions of the Adriatic Sea. During the last three years (1982-1985) more than 8000 stations have been collected, from both Italian and Yugoslavian sources. They have been uniformized in a standard format and tested for coherence. A descriptive and statistical software has been produced in order to find the most reliable description of the parameters seasonal averages. As an example of a simple Data Base utilization, the formation and diffusion of the dense Adriatic water has been studied.

1 Introduction

The Adriatic Data Base project was born in 1982 as a FAO recommendation with the aim of giving a description of the main seasonal temperature, salinity, density, chlorophyll and nutrients patterns. A first communication on program development has been given at the third Technical consultation on Stock Assessment in the Adriatic, Fano, June 1983, (Artegiani et al., 1983). A second communication has been given at Luzern (CIESM, October 1984).

During 1983-1984 Italian (IRPEM) and Yugoslavian (IOR) researchers carried out the project in relation with each other. During 1985 some difficulties prevented in maintaining the work relation between IRPEM and IOR and the program developed more slowly. Owing to these difficulties, for the first time, the presentation of a common paper on the advancement in the Data Base project was not possible. We hope that in future this international cooperation could be properly defined to consent the conclusion of the project.

The present Italian contribution to the Adriatic Data Base and an application to an oceanographical phenomenon are here briefly presented.

2 Advances in the project

The Adriatic Data Base (ADB) is at present composed of 8336 hydrological stations from 1911 to 1981, as shown in table 1:

TABLE 1: ADB Hydrological Stations

Italian Oceanographic Stations	(see references)	2836
Yugoslavian Oceanographic Stations	(see references)	4761
Other Oceanographic Stations	(see references)	739

year	n. stations	year	n. stations	year	n.stations
1911	357	1956	148	1969	137
1912	282	1957	331	1970	144
1913	429	1958	193	1971	221
1914	180	1959	75	1972	582
1915	1	1960	208	1973	547
1948	7	1961	174	1974	188
1949	7	1962	142	1975	177
1950	18	1963	291	1976	307
1951	1	1964	195	1977	401
1952	159	1965	334	1978	358
1953	157	1966	442	1979	237
1954	102	1967	331	1980	133
1955	79	1968	198	1981	31

(29 stations are undefined)

TABLE 2: Monthly Distribution of Stations

Month	n. stations	%
January	403	5
February	813	10
March	910	11
April	495	6
May	866	10
June	800	10
July	589	7
August	817	10
September	573	7
October	524	6
November	704	8
December	797	10

(45 stations are undefined)

3 Data Base Structure

The present Data Base Structure consists of two main files of standardized data (the first more compact, the second more handable) and of some working files which represent particular data aspects (i.e surface parameter, stations selected for temperature, salinity or density, standard depths values etc.). The main working file (FILE-MAP) consists in 35632 records of 132 bytes, each representing some identification keys and the values of a single parameter at 17 standard depths and at the bottom.

The parameters considered are given in table 3:

TABLE 3: Parameters Considered

code	parameter	unit	decimals
01	depth	meters	0
02	temperature	°C	2
03	salinity	‰	2
04	oxygen	%	1
05	ph	-	2
06	chlorophyl-a	mg/l	2
07	n-no2	µg-at/l	2
08	n-no3	µg-at/l	2
09	n-nh4	µg-at/l	2
10	si-sio4	µg-at/l	2
11	p-po4	µg-at/l	3
12	p-tot	µg-at/l	3

The values are given in 4 place integers

The main file contains some meteomarine parameters which have been standardized in accordance to the following codes or units:

TABLE 4: Meteomarine Parameters

echosounder depth	meters x 10
day	-
month	-
year	(19)NN
hour	HH,D (D=H/10 TMEC)
temperature dry	°C x 10
temperature wet	°C x 10
humidity	%
pressure	Mbar x 10
cloud type	WMO CODE 0500
cloud cover	WMO CODE 2700
wind direction	degrees/10
wind speed	knots x 10
weather	WMO CODE 4500
sea state	WMO CODE 3700
Secchi disk	meters x 10

4 Reliability

The data was testing for consistency and coherence using standard techniques. To correct further errors, the Adriatic sea was divided into quarters of Mardsen squares (see Code-Map in fig.1). For each region mean and standard deviation has been calculated for all parameters at standard depths and for each month. Anomalous means and standard deviations values indicate the existance of a probable error. It was thus possible to correct the greater part of input errors.



Fig. 1 - Geographical map and bathymetry (in meters) of the Adriatic sea. Seven regions ($\frac{1}{4}$ of Marsden square) are shown, in view of their importance for more detailed analyses.

Then the reliability of the measures was analyzed. This is very difficult to do because "a priori" every data must be considered true. On the other hand when the data base is used to give a description of mean hydrological situations (i.e. monthly, seasonally etc.), data obtained in different time, pattern and sampling techniques must be adjusted. From this point of view, the term reliable must be replaced with repeatable, i.e., for a small region, a mean and a confidence interval will be calculated, which indicates, at a chosen probability level, the range of values inside which a new observation in the same period and region, will fall. Under this hypothesis the Adriatic sea was divided into regions of about 12 square miles and monthly mean, percentage standard deviation and number of stations were calculated. The mean percentage standard deviation and the standard error for each stratum of equal-sized station numbers was then calculated (fig.2).

The result of this procedure, relative to temperature, is shown in fig.2. The large points represent the values of mean percentage standard deviation for every stratum. The small points represent the confidence interval at 75% probability level. As it can be seen, the first part of diagrams (size 1-11) is strictly linear-dependent from the size of strata ($r = 0.96$). The following data seem to be rather independent from the size of strata ($r = 0.04$), particularly for the greatest sizes. On the other hand, the interpolating line of confidence interval is upper-limited so that an x-axis parallel straight-line seems the best-fitting, in according to theoretical consideration. The minimum-squares method gives the following results:

a, b, and r values of the regression line $y=a+bx$

- a) first part (size 2-11): $a= 15.16$; $b= -0.58$; $r= 0.96$
- b) second part (size 12-63): $a= 9.92$; $b= -0.00$; $r= 0.04$
- c) total (size 2-63): $a= 11.22$; $b= -0.01$; $r= 0.15$
- d) stand.dev. (size 2-63): $a= 6.78$; $b= -0.00$; $r= 0.02$

The fitting-lines a) and b) are dashed in fig.2. Theoretical considerations suggest that a)-b) representation is more accurate than the c) representation. The same theoretical considerations indicate that a possible continuous fitting curve could be an exponential, asymptotically converging to the $y= 9.92$ line.

Once evaluated the confidence interval of methods, it is possible to recalculate means and standard deviations, cutting the outliers of strata distributions, probably due to sampling errors or particular situations.

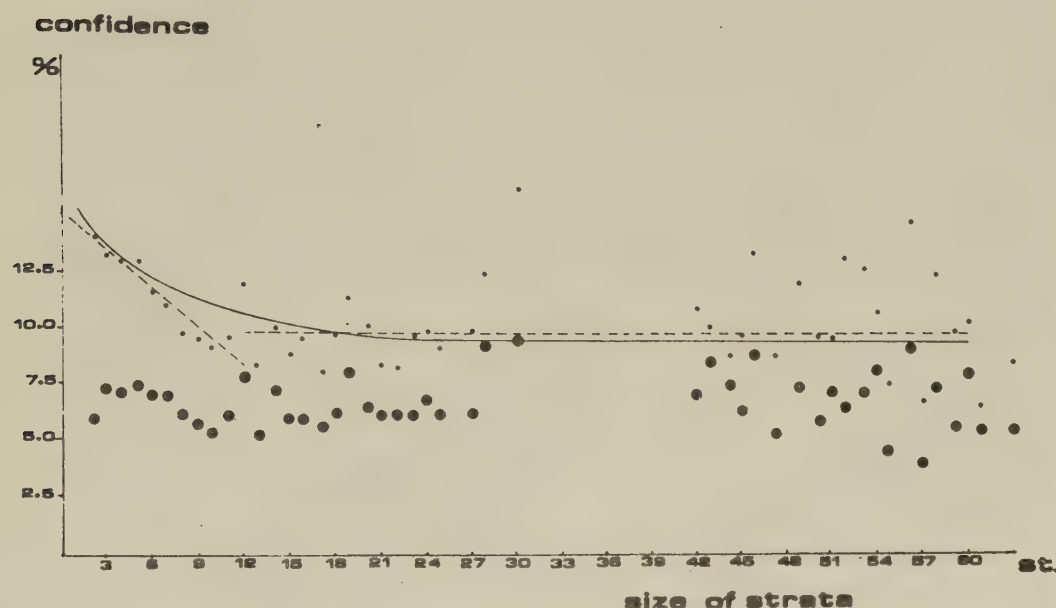


Fig. 2 - Confidence interval of method: analysis of temperature values for strata.

The size of the strata is on abscissa; the percentage standard deviation of the strata (large points) and the upper limit of the confidence interval at 75% level of the strata is on ordinate. The dashed lines are the calculated regression lines for size 2-11 and 12-63. The continuous line is an interpolating curve representing the confidence interval in function of the size of strata.

5 Dense water in the Adriatic Sea

As a first example of Data Base utilization, as statistical distribution of events, the place and periods of formation and time-evolution of the Dense Water in the Adriatic sea has been investigated. Such a phenomenon has been both theoretically and experimentally studied by various authors. It takes place in wintertime when the Adriatic sea is strongly affected by the violent blowing of the Bora, a cold dry NE wind. The sea water cools, mainly in the Northern Adriatic sea where this cooling is particularly noticeable both for the shallowness of the basin and the greater strength of Bora; on the other hand, the NW Adriatic water mixes with the rivers' fresh waters (particularly of the Po river), producing a relatively fresh water along the Italian coast but mainly in its Northern part. All this produces a dense water due to low temperature, whose TS diagram shows relatively low values in salinity. This cooling is also visible in the satellite images.

In the same period another important air-sea interaction takes place along the Yugoslavian coast, although on a smaller space-scale. Hydrological data show that dense water of the Middle and Southern part of that region display salinity values higher than in the Northern Adriatic. On the other hand, satellite images (SATMER) show a cold front, very intense but not very long, from November to February at the Southern border of Yugoslavia; high salinity and relatively low temperature give rise to salty driven dense water, whose position on the TS diagram is well separated from that of the Northern Adriatic dense waters.

The following analysis has been carried out in cooperation with prof. E. Salusti, Physical Department of Rome University

6 Density, salinity and temperature maps

The stations stored in the Adriatic Data Base are fairly regularly spread over the whole area but the Northern Adriatic Sea (NAS) is more densely covered than the Middle Adriatic Sea (MAS in the following) and the Southern Adriatic Sea (SAS in the following). Moreover, the time-spreading is rather regular, especially if periods of two months are considered, so that, in a first rough approach, our spatial distribution of stations can legitimately be considered as a reasonable statistical distributions of events. The distribution of stations in six two-monthly periods and in every quarter of Marsden square, is shown in figures 3. Large triangles are indicative of more than 50 stations, medium triangles of 11-50 stations, small triangles of less than 10 stations. It can be seen that the Middle



Fig. 3 - Geographical map and temporal distribution of hydrological stations, in each geographical Region ($\frac{1}{4}$ of Marsden square) and two months periods. Large triangles are indicative of more than 50 Stations, medium triangles of 11-50 Stations, small triangles of less than 10 Stations.

and Southern regions are less regularly studied; in particular the Southern coastal area (shelf break off Puglia region) is a little known area, which is particularly unfortunate!

Let us start by examining the geographical distribution of those Stations in which at some depth a σ_t greater or equal to 29.6 has been found. Generally from that depth to the bottom σ_t increases. Informations about the thickness of these layers of dense water could be very interesting but since they strongly depend on the year's climate (or on salty Mediterranean water rate of inflow into the Adriatic sea, according to Buljan (1953), then the values of this parameter can be misleading and need a careful time-dependent analysis.

These $\sigma_t \geq 29.6$ Stations, are seen to be rather dense in the Northern Adriatic sea (NAS) in January and February, with a total amount of 51 Stations North of the 44th parallel. Inside the Middle Adriatic Pit (MAP, in the following) there are 3 Stations, as many as on the Split-Gargano line (SGL, in the following). In March-April most of the NAS Stations have moved southward, approaching the Italian coast. This movement is of ≈ 200 km over ≈ 2 months, corresponding to a mean velocity of about 4 cm/sec (see the theoretical estimate of Shaw and Csanady, 1984). Around and inside the MAP there are now 26 Stations and on the SGL there are 6 Stations. This evolution suggests that the dense-water motion consists in a general movement toward the Ionian sea. Unfortunately the flow at the Southern border of the shelf is impossible to detect since the shelf-break zone is not covered by a sufficient number of Stations. During the following months this tendency continues: in the NAS, Stations with $\sigma_t \geq 29.6$ gradually disappear, although some remain in the MAP and SGL. The general decrease with time in the number of Stations continues also in December and new $\sigma_t \geq 29.6$ dense water is observable only in next January-February period.

The same tendency in time can be observed for the $\sigma_t \geq 29.4$ Station although they are much more numerous (fig.4). In January-February there are 130 NAS Stations, 13 MAP Stations and 4 SGL Stations. The same happens in the other periods of the year but near the Pelagosa Island, north of Gargano, the dense water Stations are also very frequent. Inside the Southern Adriatic Pit (SAP) the dense water Stations are very unfrequent (1 in September-October, 3 in November-December).

Stations with $\sigma_t \geq 29.2$ are more frequent all the year and display the same tendency.

If we now examine the time and space spread of those Stations whose Salinity is at least once higher or equal than $S \geq 38.8\%$, 38.6% , and 38.4% , respectively, it can be seen that in January-February Stations with $S \geq 38.8\%$ are frequent on the SGL (10 Stations) and along the Yugoslavian coast between Split and Dubrovnik, in agreement with the cold patches observed in the satellite images. In NAS and in MAP they have been found only in a few cases (3 and 2). The same happens during all the year, with the only exception of May-June in which the number of $S \geq 38.8\%$ Stations on the Split-Gargano line (SGL) is comparable with that of Middle Adriatic Pit (MAT).

About the $S \geq 38.6\%$ Stations, their distribution resembles that of the $S \geq 38.8\%$ case but some Stations can be found also in NAS. The SGL is very rich in high salinity Stations. These Stations are again numerous in December. In the SAP, $S \geq 38.8\%$ Stations can be seen only after March-April.

The opposite situation results from temperature plots. Stations with temperature of less than $T = 10.20^\circ\text{C}$ are frequent in NAS during January-February. Their number decreases in NAS during March-April and May-June (only in July-August they totally disappear, a very interesting fact!) and conversely increases in the MAP, showing the same southward movement as discussed above for the density field. Few of these Stations can be found near the Yugoslavian coast.

A further check is of interest; we plotted the cold dense sea-waters, i.e. these $\sigma_t > 29.4$ waters that, moreover, had $T < 11.3^\circ\text{C}$ and $S < 38.4\%$, obtaining the $\sigma_t \geq 29.4$ waters whose

density is due to low temperature. These cold dense waters were mainly localized in the North-Western part of the basin (fig.4, on the left of dark lines). The corresponding salty waters ($T \geq 11.3$ °C, $\sigma_t \geq 29.4$, $S \geq 38.4\%$) showed the interesting feature of being localized also in the central part of NAS, but always South of $44^{\circ}.45'N$ (fig.3, on the right of the dark lines). It is, however, of interest that, in NAS, only in September are temperature values higher than 11.30 °C. In the MAP this cold water is always present, while only in March-April it can be found in the SAP.



Fig. 4 - Geographical and temporal distribution of hydrological Stations in which a density larger than 29.4 has been observed.

7 Temperature and salinity of the bottom water; time and space averaged T-S diagrams

The preceding analysis suggests that the main source of the dense Adriatic sea water is located in NAS. Moreover, very salty water can also be found between Dubrovnik and Split also if the density is generally lower than that of NAS. The time evolution of these components of dense water was studied in greater detail by examining, through some particular T-S diagrams (fig.5), the annual time-evolution of the densest bottom waters found in some Regions ($1/4$ of Murdsen square) of particular interest, shown in fig.1. As we are dealing with dense waters, we shall take into account only those waters whose density is ≥ 29.2 .

In this paragraph we show the time (two months) and space (every Region) averaged values of $T(b)$, $S(b)$ and $\sigma_t(b)$, where b is the bottom depth. In fig.5 we show the T-S diagrams at the bottom. The small points represent the mean weighted value over

each two-month period. The small numbers nearby are those of the corresponding regions. The large points represent the weighted mean values over the whole year with, nearby, the numbers of the relative Regions.

The resulting pattern is very interesting. The water of NAS (#1, mean depth $\approx 35\text{m}$) and of the Split Region (#2, mean depth $\approx 85\text{m}$) are well separated both for temperature and salinity. The two MAP Regions (#3, mean depth $\approx 190\text{m}$ and #4, mean depth $\approx 231\text{m}$) are badly separated (the Western part is a little warmer than the Eastern one) and lie in the middle between the NAS and the SAP Regions waters (#6, #7) and twice as from Split Region (#2) water as from NAS (#1) water. The saddle region (#5, mean depth $\approx 158\text{m}$) water has the same pattern as the Eastern part of MAP but it results to be little fresher, thus confirming the pattern obtained from the examination of the T-S extremal values in the preceding paragraph. Last, Regions #6 (mean depth $\approx 1050\text{m}$) and #7 (mean depth $\approx 1070\text{m}$) display almost the same behavior, and are warmer and saltier than the MAP and NAS waters. The new Eastern region (#7) seems to be a little warmer and saltier than the other one. Moreover, the density of these two last Regions only sometimes reaches the values of the MAP and Saddle Regions densities, thus showing that the water masses over the shelf are generally denser than those found in much deeper layers.

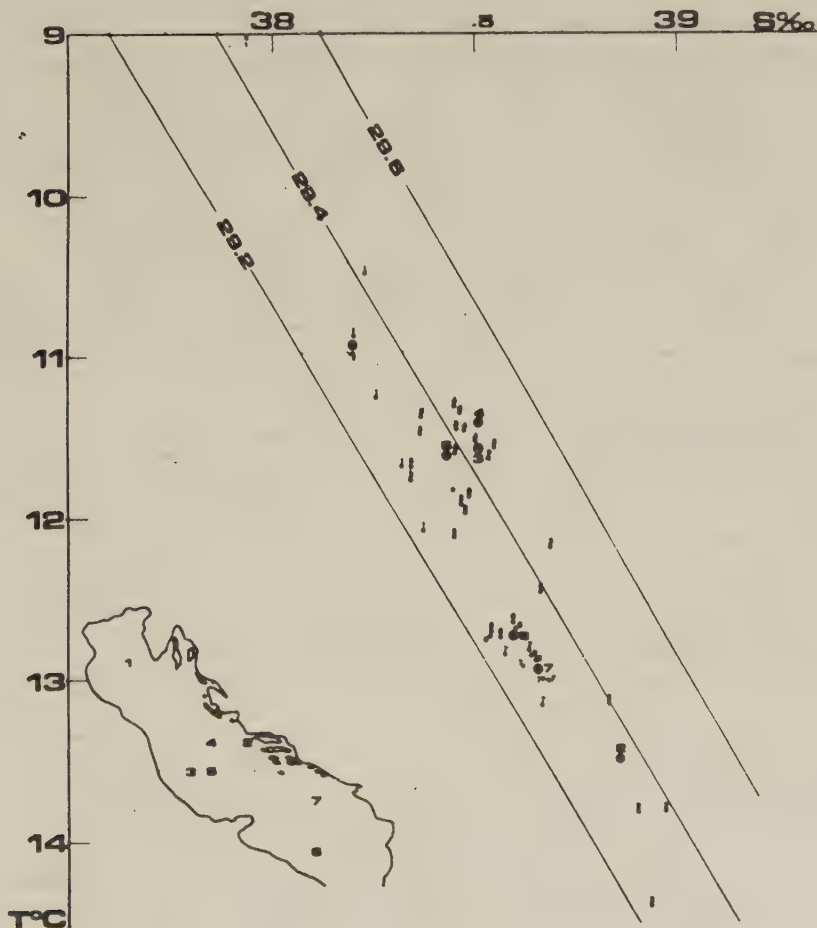


Fig. 5 - Time (over two-months periods) and space (over a $\frac{1}{4}$ of Marsden square Region) average of bottom temperature and salinity for Regions #1 to #7. Small points and small numbers are for a two-months period; the large points and numbers refer to the whole year.

8 Discussion

To discuss these data we make the reasonable assumption that dense water flows cyclonically on the bottom of the Adriatic basin, driven by the main circulation of the Adriatic sea. On the other hand, both theoretical and experimental results suggest that this movement is in agreement with the conservation of potential vorticity, i.e. the streamlines follow the isobaths to a large extent.

As main results we have that the most important sources of $\sigma_t \geq 29.4$ waters are in NAS (January-April) and along the Southern coast of Yugoslavia between Dubrovnik and Split, in the same period, in agreement with satellite observations. The dense waters coming from the two different sources have different time-dependent T-S diagrams and this allows us to follow their different fates.

In order to illustrate these different time-evolutions more effectively, we prefer to introduce a "salt water" circulation model (SW) and a "cold water" circulation model (CW) (fig.6). The CW arises in the Northern Adriatic sea, affecting almost the whole water column. It remains there for a rather long time, probably trapped in the circulation of the NAS (one can find water with $T < 10.20^\circ\text{C}$ till June, as first mentioned by Franco, 1970). In March-April period, part of this CW moves Southward along the Italian coast, which is in apparent agreement with the conservation of potential vorticity. Theoretical considerations suggest that this water forms a well defined vein (or rather a continuous set of blobs) of dense, cold water flowing alongshore at a depth of 50-150 meters. It is very interesting that this theoretical idea has found experimental support (Franco and Bregant, 1980, Artegiani, 1983) in field observations near Pescara, between the Italian coast and the MAP, and in field observations at the shelf break off Gargano, on the Southern part of this flow (Zoccolotti et al., 1985). It is of primary importance that the field observations confirm that this water can flow regularly along isobaths, without sinking completely into the MAP. Moreover we can see that the friction has an interesting effect: a small part of slower and deeper water can often be observed further offshore and deeper than the main vein.

Moving more southward, this vein reaches the shelf break South of Gargano, producing a complex (buoyancy versus mixing) event.

A rough estimate of the flux of this water has been given by Zoccolotti et al. (1985) in about 10^6 - 10^8 m^3/sec .

The SW circulation seems to have a totally different evolution. It is formed approximately in the same winter period, in the region between Split and Dubrovnik. It is, moreover, possible to observe, even during August, a thin (≈ 20 meters) layer of dense ($\sigma_t \geq 29.4$), salt water over a bottom of about 100 meters. Complex phenomena must be present since during all the year this thin layer of dense, salt water can be seen. Such a salt, dense water cannot be observed further North-West of Split but can be found again ($\sigma_t \geq 29.4$, $S \geq 38.4$) in the central part of NAS. A possible reason for this effect is that SW is cyclonically driven by the general circulation of the Adriatic sea, but its densest part, being located at a depth of ≈ 60 -80 meters, cannot give rise to isobaths because of the potential vorticity conservation. Consequently it cannot flow further northward and is therefore obliged to turn West following the isobaths of the Eastern MAP. The lighter part of SW probably intrudes into the NAS. Comparison with T-S diagrams of the above Regions allows us to identify the presence of SW inside the bottom MAP dense water and suggests that the SW, during its cyclonic flow, interacts with the CW, giving rise to the bottom water of the two lobes of Jabuka Pit (MAP).

Although little evidence is available concerning the fate of this MAP water, the most reasonable hypotheses suggested by the σ_t plots and the T-S diagrams of the saddle Region (#5), is that this water will be affected by further mixing processes with more superficial, and therefore less dense, waters. The resulting mixed water becomes to be less and less dense, until it is

finally pulled out from the influx of new dense water.

These analysis suggest a general model for the dense water formation and evolution in the Adriatic sea. Many fundamental problems arise: The continuity of the cold water vein, its stability, its trapping along the Yugoslavian coast, are points to be studied in greater details. Also the motion of the dense water after it has been trapped by the MAP is an obscure but fundamental aspect that could be probably compared with the flow of dense water flowing outside the Mediterranean sea through the Straits of Gibraltar.

In any case, further and deeper knowledges on the Adriatic circulation, and particularly of its bottom dense water, appear as a fundamental contribution to any policy of marine resources. From this point of view, the Adriatic Data Base, also in its simples versions and utilizations, seems to be a fundamental instrument of knowledge and study.

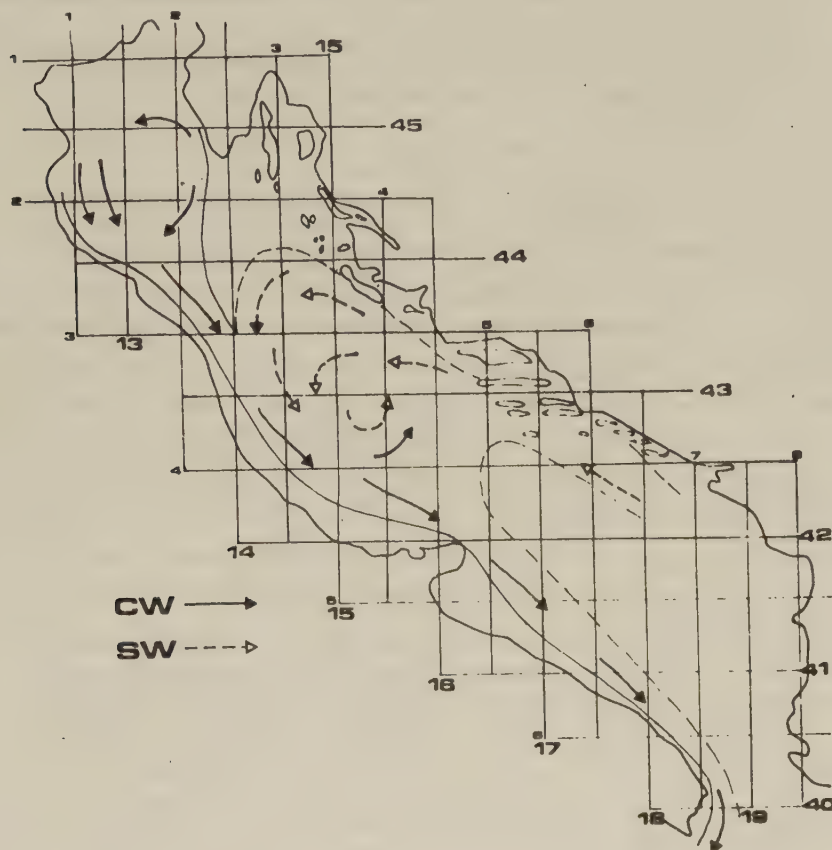


Fig. 6 - Schematic diagram of Cold Dense Water (CW - dark line) and Salt Dense Water (SW - dashed line) circulation.

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ANNEX (E) E

PROGRESS REPORT ON THE PREPARATION OF ATLAS OF HYDROGRAPHY
FOR THE ADRIATIC SEA

by

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The Adriatic Data Base project was born in 1982 in the frame of Italian-Yugoslav cooperation on the Adriatic stock assesment. Recomendation by FAO was to give a description of the mean seasonal temperature, salinity, density, chlorophyll and nutrient patterns. The first progress of the program was submitted at Fano CGPM (Artegiani et al. 1983). The second communication was presented at Luzerne (CIESM, October 1984).

Italian (Ancona) and Yugoslav (Split) group have kept repeatedly in contact since last technical consultation except in 1985 due to some difficulties which prevented necessary cooperation and the program developed more slowly. Due to the fact that the task to be accomplished is that comprehensive, new scientists have been included in the program, so that at present the following experts are engaged:

Ancona (IRPEM) group

Antonio Artegiani
Roberto Azzolini
Elio Paschini
Mariella Morbidoni

Split group

Mira Zore-Armanda
Miroslav Gačić
Zoran Vučak
Nenad Leder
Ivica Marčić
Arsen Puškarić
Vlado Dadić

All the data collected so far have been exchanged and decision was made to work on processing parallel in Split and Ancona so to be able to compare results at all stages and select better methods. Number of stations is now extended to about 9000 which represents sufficiently large Data Base. Due to different methods in data filtration Data Base is not identical in Split and Ancona at the moment, but effort will be done to overcome the differences. Both groups worked on standardisation of formats, data filtration and verification.

The aim of the program in the nearby future is to create such statistical methods which will exclude hand-made approach and so become as realistic as possible. Frequent personal contact between the experts of two groups are indispensable to arrive to the final results.

During the first phase work was based on data collected in the period from 1911 to 1915 and from 1948 to 1981. The 6288 oceanographic stations were taken into consideration of which 1249 in the period 1911-1915, and 5039 in the period 1948-1981.

Although the data were formatted in two different ways, due to specific needs, both groups, Italian and Yugoslav, contributed to the data collection.

Record structure e.g. format of different origin were not compatible and it was necessary to reformat all basic and oceanographic records. Italian file was created in this way: oceanographic data records for all depths are followed by basic record, opposite to Yugoslav file where deep-sea records for all oceanographic parameters are followed by basic record. Because of that, it was necessary to transform all oceanographic records to deep-sea records, to make them compatible with the existing Yugoslav files and programs.

At present Data Base is composed of all data mentioned in addition to data collected from the Institute of Oceanography and Fisheries in the period from 1971 to 1980. Data entering in this data file was not performed by editor but was made with program based on Digital's Form Management System (FMS). Only numerical data can be entered in this way and possible errors in positioning data in records were eliminated. Checking of the data was performed in different ways depending on oceanographic parameters.

The most important part was to determine correct longitude and latitude with corresponding station identification number written in the file. For this purpose two programs were created; one for listing all different coordinates of stations followed by manual checking and other for separating and correcting coordinates.

Also, the program for processing deep-sea records was created. It was intended to indicate incorrect temperature, salinity or oxygen data. Generally, density increases with depth, so that is a reliable indicator of correctly entered temperature and salinity data. But decrease of density with depth less than 0.02/10m is taken to be tolerable. For deviations greater than the above mentioned, all data are listed. So the temperature and salinity irregularities are identified very easily. Comparison with original data could help to see whether the error was caused by data entering, measurement or some anomaly present in the sea.

For saturation with oxygen all values greater than 120 % are considered incorrect.

The next step was to create applicative software by which a basic statistics of temperature and salinity fields in the Adriatic Sea could be obtained.

At first the program which separates interesting squares from the united data (Italian and Yugoslav) was created. It was done by searching over latitudes and longitudes in a given interval. Simultaneously it was realized by accounting of basic records and parametric records. Total data number for each square was calculated and joined to a proper square. At this step the chart was drawn manually. The automatization explained in the further discussion will be the next step of this work.

Data processing will be done in respect to seasons in the following way: February, March; for winter May, June; for spring August, September for summer and November, December for autumn.

For so defined seasons mean geographic longitude and latitude could be calculated for each square to obtain "representative point" for each season.

The program has also been created to calculate temperature and salinity means for each square for particular season. Besides that the program calculates standard deviation, regression coefficient, standard deviation of regression coefficient, standard error of estimate, correlation coefficient of all variables and finally multiple correlation coefficient.

A program for converting data of longitude and latitude from the chart into digitalized data is the next step in the realization of the task. These data should be stored in a file on a disc. Sampling of points (density of points) is solved by the program in the way that one chooses a method (and there are 6 of them) which is at a moment the most interesting for user.

Stored data could be read from a magnetic disc and drawn on plotter by using the program for drawing. Simultaneously the Adriatic coast will be drawn as well as the net of Mardsen's squares.

Representative points for particular squares shall also be drawn. Through these points a curve of interpolation of fields (temperature and salinity) will be drawn.

A method of optimum interpolation will be used which is one of the most promising method of objective analysis.

ANNEX (E) F

Résultats pratiques du programme de recherche "Etude de faisabilité pour un
système d'échantillonnage des statistiques de pêche"
(programme PESTAT)

par

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Istituto di Ricerche sulla Pesca Marittima - Ancona

Le programme de recherche PESTAT a été réalisé par l'Institut de Recherches sur la Pêche maritime d'Ancône (I.R.P.E.M.) sous financement du Ministère de la Marine marchande (Loi n. 588/75 et Loi n. 41/82).

Objectifs de la recherche

Les objectifs de la recherche PESTAT sont essentiellement trois:

1. Fournir à l'organe politico-administratif de la pêche (Ministère de la Marine marchande) un cadre complet des insuffisances relevées au niveau périphérique, pendant le recueil des données statistiques, avec l'indication des solutions optimales qu'il faudrait adopter pour l'organisation des bureaux statistiques, le choix du personnel et des méthodes, en vue d'un recueil uniforme et fiable des données sur la pêche.
2. Fournir à l'organe officiel des statistiques (ISTAT) le savoir faire acquis par l'I.R.P.E.M. en vue du passage graduel de l'ancien système au nouveau, déterminé par les résultats de recherche.
3. Fournir comme objectif immédiat un rapport sur la situation de la pêche avec une mise à jour concernant:
 - a) Les bateaux de pêche: caractéristiques des embarcations, leur distribution le long des côtes, appareils électroniques de navigation et de détection des bancs de poissons, équipements présents pour la manoeuvre des filets de pêche, type des engins de pêche employés à bord, métiers etc.
 - b) Les données des captures et d'effort de pêche pour deux années pour les comparer avec les données officielles et donc corriger les séries historiques.

Il va de soi qu'à partir des résultats des points a) et b) on peut mettre au point la situation statistique des bateaux et des captures, obtenir le relevé de l'effort de pêche et créer la base pour un système neuf et rationnel de statistiques de pêche.

Résultats de la recherche PESTAT

La recherche PESTAT s'est étendue avec le temps des 23 Capitaineries de Port prévues initialement à la totalité des 43 Capitaineries.

La partie de la recherche concernant la flottille de pêche a abouti et les résultats ont été publiés récemment. (Voir tableaux 1 et 2). L'élaboration des données de capture et d'effort est en cours. La recherche a produit des résultats pratiques importants qui ont été transférés et appliqués à la réalité de la pêche italienne. Les organismes suivants utilisent les résultats de la recherche PESTAT:

EUROSTAT (Organisme de la CEE pour les statistiques communautaires)

Le premier juillet 1981 une copie de la bande magnétique contenant les archives des bateaux de pêche relevés dans les Registres "Matricole"^{rk} et dans les Registres des Navires mineurs et Chalands, a été livrée à l'ISTAT^{**} qui l'a transmis (le 1/10/1981), après conversion dans la norme EUROSTAT. A partir donc du mois d'octobre 1981 les données archivées par la CEE concernant la flotte italienne proviennent de PESTAT. Par la suite l'ISTAT a effectué une mise à jour des données officielles.

Ministère de la Marine marchande

Une copie électronique des archives PESTAT a été remise au Ministère de la Marine marchande qui a pu disposer d'une liste pratiquement complète et à jour de toutes les embarcations de pêche italiennes, accompagnée des données et des caractéristiques plus significatives pour chaque bateau. Ceci est de la plus grande importance pour la programmation de l'activité de pêche et pour la réglementation de l'effort de pêche que le Ministère s'apprête à réaliser, dans l'esprit de la Loi n. 41/82.

ISTAT (Institut central de Statistique)

L'ISTAT a utilisé entièrement les données de la recherche PESTAT sur les bateaux de pêche, soit pour les communiquer aux archives communautaires, soit pour la mise à jour de ses propres données.

A partir de 1984 l'ISTAT a remplacé ses modèles de relevé (ISTAT/A/101) par les nouveaux modèles ISTAT/A/110 et ISTAT/A/111 tirés entièrement de la méthodologie proposée par le programme PESTAT: ces modèles ont été préparés par le "Groupe de travail sur les statistiques de la pêche" prévu à l'article 5 de la Loi n. 41/82, groupe auquel participe l'I.R.P.E.M. avec son personnel qualifié. Certainement ces modèles et la méthodologie de relevé appliqué sur le terrain sont encore perfectibles. Maintenant les modèles de relevé, avec toutes les données concernant chaque bateau, imprimées auparavant par l'archive électronique nationale (ISTAT), sont envoyés, en double copie, aux Capitaineries de Port qui y apportent les modifications nécessaires au fur et à mesure qu'elles se produisent dans la réalité de la flottille. Les modèles ainsi révisés sont chaque année renvoyés à l'archive électronique nationale (ISTAT) pour la mise à jour de la situation.

Les nouveautés, par rapport au passé, sont diverses et importantes:

- a) utilisation de personnel qualifié pour les statistiques de pêche au niveau des Capitaineries;
- b) situation statistique de la flottille continuellement mise à jour;
- c) normalisation des modèles;
- d) possibilité pour les institutions scientifiques de disposer de séries historiques de données fiables sur la flottille de pêche.

* Concernant les bateaux qui ont le certificat de navigabilité pour les eaux au-delà de 20 milles.

** Organisme institutionnel des statistiques italiennes.

Deuxième partie de la recherche PESTAT

La recherche PESTAT, pour la partie qui concerne les captures et les efforts de pêche, n'est pas encore arrivée à sa conclusion. L'élaboration et l'analyse des données est actuellement en cours. Cette phase a pris deux années de travail sur le terrain et a intéressé plus de 65 sites le long des côtes italiennes. Les données relevées ont été fichées dans l'archive électronique de l'I.R.P.E.M. qui couvre actuellement 220.956 relevés de 500 bytes chacun.

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Studio di fattibilità per un sistema di rilevazione campionaria delle statistiche della pesca. Parte I. Statistiche sulla flottiglia da pesca. Quaderni del Istituto di Recherche Pesca marittima, 4 (1 suppl.): XVI 358 pp.

Tableau 1 : FLOTTILLE DE PÊCHE ITALIENNE

	MECANISES ^{1/}			MOTORISES ^{2/}			MECANISES+MOTORISES			NON MOTORISES		TOTAL
	Nombre	TJB	Ch	Nombre	TJB	Ch	Nombre	TJB	Ch	Nombre	TJB	Ch
ITALIE	6475	166734	955285	12730	42579	352685	19205	209313	1307970	10685	13636	29890
HAUTE ADRIATIQUE	633	11084	122178	1538	5079	60982	2171	16163	183160	877	964	3048
MOYENNE ADRIATIQUE	1244	40582	208102	908	2431	21525	2152	43013	229627	658	656	2810
BASSE ADRIATIQUE	856	20308	114608	725	2325	15712	1581	22633	130230	1584	1740	3165
TOTAL ADRIATIQUE	2733	71974	444888	3171	9835	98219	5904	81809	543017	3119	3360	9023
% ADRIATIQUE/ITALIE	42.2	43.2	46.6	24.9	23.1	27.8	30.7	39.1	41.5	29.1	24.6	30.2

^{1/} Le treuil est actionné par le moteur principal.

^{2/} Le treuil, quand il existe, n'est pas actionné par le moteur principal.

Tableau 2 : FLOTTILLE DE PÊCHE ITALIENNE - NAVIRES MECANISES PAR METIERS

	SENNE		CHALUT		"VONGOLARA"		ENGINS FIXES		NASSES		PALANGRE		AUTRES		NON INDIQUE		TOTAL	
	Nombre	TJB	Nombre	TJB	Nombre	TJB	Nombre	TJB	Nombre	TJB	Nombre	TJB	Nombre	TJB	Nombre	TJB	Nombre	TJB
ITALIE	359	6635	2192	81047	317	2548	1270	7305	24	82	136	1585	10	150	2167	67382	6475	166734
HAUTE ADRIATIQUE	8	143	200	3184	47	510	36	318	1	6	2	8	1	3	338	6912	633	11084
MOYENNE ADRIATIQUE	9	574	461	14832	147	1241	34	160	5	17	0	0	0	0	588	23758	1244	40582
BASSE ADRIATIQUE	21	497	628	17896	45	362	119	805	0	0	2	30	0	0	41	718	856	20308
TOTAL ADRIATIQUE	38	1214	1289	35912	239	2113	189	1283	6	23	4	38	1	3	967	31388	2733	71974
% ADRIATIQUE/ITALIE	10,5	18,3	58,8	44,3	75,3	82,9	14,8	17,6	25,0	28,0	2,9	2,4	10	2	44,6	46,2	42,2	43,2

Tableau 3 Add. 1 : FLOTTILLE DE PECHE ITALIENNE - NAVIRES MOTORISES PAR METIERS

	SENNE		CHALUT		"VONGOLARA"		ENGINS FIXES		NASSES		PALANGRE		AUTRES		NON INDIQUE		TOTAL	
	Nombre	TJB	Nombre	TJB	Nombre	TJB	Nombre	TJB	Nombre	TJB	Nombre	TJB	Nombre	TJB	Nombre	TJB	Nombre	TJB
ITALIE	151	484	194	875	72	281	2141	5863	92	173	318	1488	28	150	9724	33265	12730	42579
HAUTE ADRIATIQUE	6	46	26	92	3	19	200	490	0	0	1	4	0	0	1302	4428	1538	5079
MOYENNE ADRIATIQUE	4	9	97	325	21	137	163	270	41	43	0	0	0	0	582	1647	908	2431
BASSE ADRIATIQUE	24	59	48	271	9	43	516	1566	1	4	11	26	1	3	115	353	725	2325
TOTAL ADRIATIQUE	36	114	171	688	33	199	879	2316	42	47	12	30	1	3	1999	6428	3171	9835
% ADRIATIQUE / ITALIE	13,8	23,5	88,1	78,6	45,0	70,8	41,0	39,6	45,6	27,1	3,6	2,0	3,6	2,0	20,5	19,3	24,9	23,0



ISTITUTO CENTRALE DI STATISTICA
MINISTERO DELLA MARINA MERCANTILE
D.G. PESCA MARITTIMA - DIV. XXII

SCHEDARIO DEL NAVIGLIO ADIBITO ALLA PESCA

ADD.2

MOD. INTAT/2/1991

Compartimento Marittimo di

Ufficio

N° D'ORDINE DEL
MOD. STAT/2/110

IDENTIFICAZIONE DELLA NAVE

NOVE	NOIE	NOMINATIVO INTERNAZIONALE
N° DI MATRICOLA N° DEL R.N.M.G.	T.S.N.	

S.C.A.F.O.

CANTIERE DI COSTRUZIONE	DIMENSIONI (in metri)	MATERIALE DI COSTRUZIONE
LUOGO DI COSTRUZIONE	LUNGHEZZA FUORI TUTTO	SCONOSCIUTO
ANNO DI COSTRUZIONE	LUNGHEZZA TRA LE PERPENDICOLARI	LEGNO
ANNO DI ENTRATA IN ESERCIZIO	LUNGHEZZA DI STAZZA	ACQUA
	ALTEZZA DI STAZZA	ALUMINIO
		PLASTICA
		ALTRA

PROPULSIONE

- MOTORE A ENTROBORDO	POTENZA H.P.	DATI RELATIVI ALL'ULTIMO MOTORE ENTROBORDO INSTALLATO
Numero motori	NUMERO CILINDRI	TIPO DI MOTORE
- MOTORE FUORIBORDO	NUMERO CILINDRI	DIESEL
- NON MOTORIZZATA	ANNO DI COSTRUZIONE	DIESEL ELETTRICO
		A BENZINA
		ALTRA
		NON NOTO

SISTEMA DI PESCA

STRASCICO	VOLANTE A COPPA	CIRCUZIONE	PALANGARI	POSTA	DRAGA PER VONGOLE ecc.	ALTRA SISTEMA
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APPARECCHIATURE

RADIO ELETTRICHE	PER IL REPERIMENTO DEL PESCE	ECOSCANDAGLIO	SONAR	ALTRA
RTT	RTT	ECOSCANDAGLIO	SONAR	ALTRA
RADAR	RADAR	ECOSCANDAGLIO	SONAR	ALTRA

CONSERVAZIONE DEL PESCE

CONGELATORE	FRIGORIFERO	GHIACCIATA	ALTRA ATTREZZATURA	NESSUNA ATTREZZATURA
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COMPOSIZIONE MINIMA DELL'EQUIPAGGIO

PROPRIETARI	NUMERO PERSONE
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PROPRIETARI

COGNOME	NOME	COMUNE DI NASCITA	DATA DI NASCITA	INDIRIZZO (via, n° civico, comune, provincia)
INDIVIDUALE	INDIVIDUALE	INDIVIDUALE	INDIVIDUALE	INDIVIDUALE
COOPERATIVA	COOPERATIVA	COOPERATIVA	COOPERATIVA	COOPERATIVA
SOCIETA' DI CAPITALE	SOCIETA' DI CAPITALE	SOCIETA' DI CAPITALE	SOCIETA' DI CAPITALE	SOCIETA' DI CAPITALE

ANNOTAZIONI

VERIFICATA O COMPIUTA DA	VERIFICATA O COMPIUTA DA
IL CAPO SERVIZIO NAVIGLIO	IL CAPO SERVIZIO NAVIGLIO

ANNEX (E) G

The small scale fishery along Italian Adriatic coasts

by

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1. Introduction

Present distribution of fishing effort and gear preferences on the two sides of the Adriatic sea are the result of geomorphological differences and local fishing traditions.

The eastern Adriatic is characterized by rocky shores with higher depths and rough bottoms; so it is more favourable to a nearshore fishery with fixed gears.

The western Adriatic is characterized by shallow depths and soft bottoms. This situation over the years stimulated the development of an important bottom trawl fishery.

Nevertheless, a small scale fishery is also present all along Italian Adriatic coasts and, because of its lower operating expenses, in the last years showed a continuous development.

2. Source of Data

Data herein presented are based on investigations carried out in the early '80s: PESTAT statistical survey on the Italian fishing fleet (Bazigos et al., 1984), local surveys on the hydraulic clam dredges (Frogliani, in press) and on the coastal zone licenced trawling boats (Fiorentini et al., 1984).

3. Results and Discussion

Small scale fishery is an ill-defined category and mostly includes boats with less than 10 GRT operating within three miles from the shore. In the northern Adriatic boats with hydraulic clam dredges exploiting the "Fasolaro" Callista chione and in the southern Adriatic boats fishing for swordfish with drifting long-lines are two exceptions to this rule worthy of mention.

Data are presented in Figs. 1 and 2 subdivided by Districts (Compartimenti marittimi). Boats are sorted by engine power classes (HP class) and within each class total number of boats and overall GRT are reported.

Keeping in mind the low mobility of nearshore fishermen, this arrangement of data may result in a good estimation of the fishing effort exerted in each area.

3.1 Hydraulic Clam Dredges

The coastal sands of the western Adriatic are characterized by a "Venus community" and Chamelea gallina supports an important fishery (nearly 600 boats) that is here considered separately from the remaining "small scale fishery" (Fig. 1).

For this particular fishery a licence system is at present enforced in Italy. Number of boats and their characteristics were obtained from the registers kept in the Port Offices. Licenced boats are allowed to fish in the registration district (Compartimento marittimo) and sometimes in the contiguous ones. Three other species are harvested in the northern Adriatic sea by means of hydraulic clams dredges: Callista chione, Venus verrucosa and Ensis minor. Whereas the first two species are caught on offshore detritic sands (depth 15-25 m), the razor shell

(*E. minor*) is caught on fine beach sands (depth 1-3 m). Razor shell stock is probably over-exploited (production decreasing) in the northern Adriatic (Compartimento di Monfalcone) where fishing season is now restricted to winter months (Del Piero et. al., 1980)

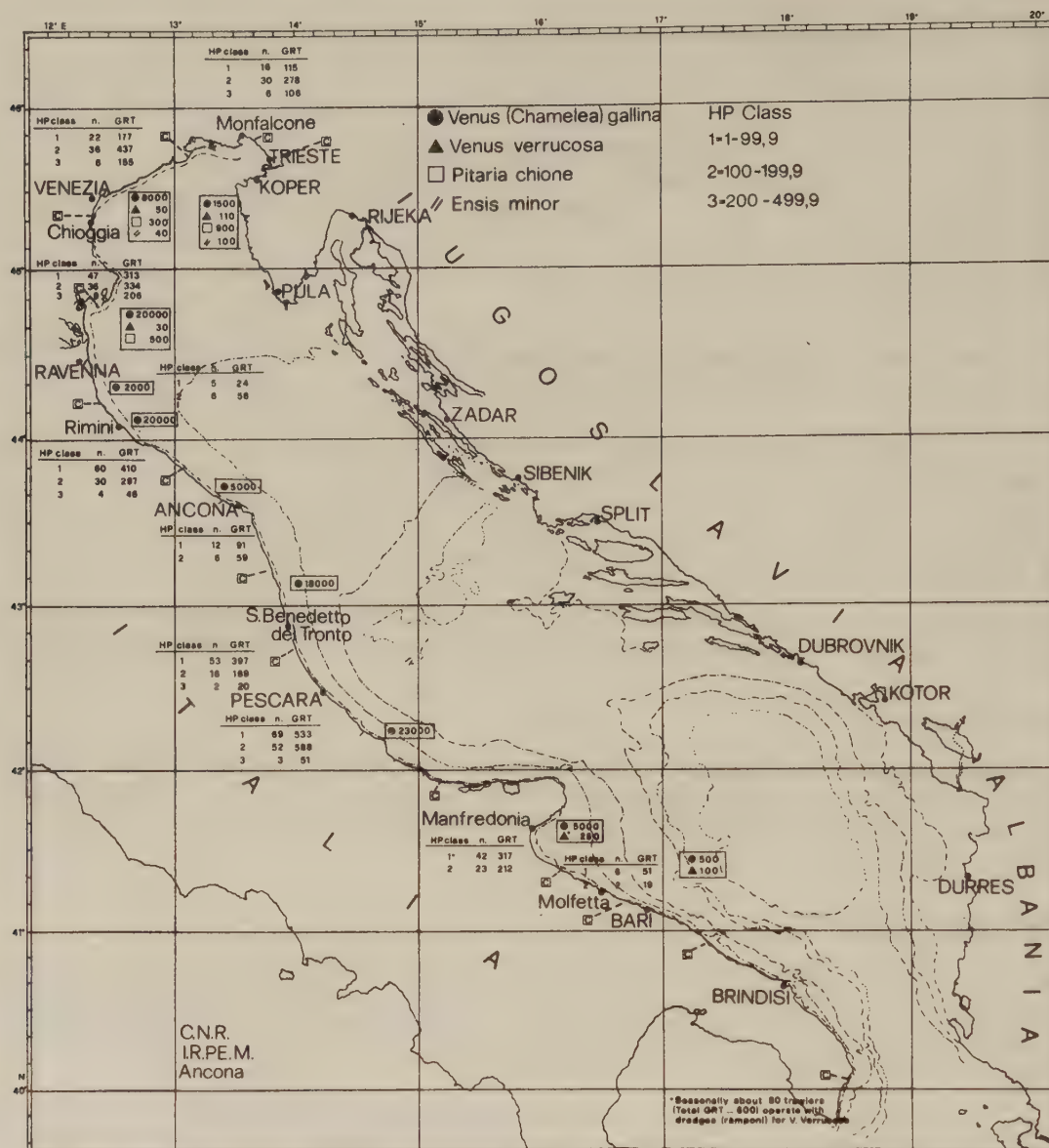


Fig. 1 - Fishing effort (Number and total GRT) of hydraulic clam dredges and estimated clams production along the Italian Adriatic coast.

Yearly production of the four main species in the hydraulic clam dredge fishery was estimated by interviews to wholesale dealers, leaders of fishermen organizations and from daily catches reported by a small number of selected boats. Data can be considered an average for the years 1980-82 and are reported (Fig. 1) for each Compartimento marittimo. It is evident that *C. gallina* with a yearly production estimated at 100,000 tons is by far the most important species.

Until now nearly all the hydraulic clam dredges are highly specialized boats, sometimes shifting their interest from one species of bivalves to another; rarely alternating net setting and clam dredging.

3.2 Other Small Scale Fisheries

Fishermen working with fixed gears (gill nets, trammel nets, long-lines and pots) frequently change from one gear to another according to seasonal fluctuations of species abundance. Bottom trawls may also be used. It is impossible to quantify fishing effort for each type of gear and the best estimation of the overall fishing pressure is given by the number of boats, and their total GRT, present in each district.

Production estimates for this fishery are extremely difficult because catches are mostly sold outside fishmarkets, and no record exists for these landings. The second phase of the PESTAT program was designed to estimate, with a sampling approach, the catch and effort data for all fishing categories, including the small scale fishery.

All along the Adriatic, for about two years (1981-1983) on 22 selected landing places, data were collected weekly on representative samples of the active boats.

All information is already stored on magnetic tape; its analysis is in progress and will soon be finished. From its results the role of the small scale fishery in the Adriatic sea will be better understood. The peculiarity of this small scale fishery in some Districts comes out already from preliminary analysis and from information gathered during other investigations, and seems worthy of mention.

3.2.1 Northern Adriatic (Trieste, Monfalcone, Venezia)

Trieste is the only Italian district where drifting gill nets are still used to catch sardines. About 50 boats operate seasonally, with an estimated catch of 400 tons/year.

Trammel nets activity in Trieste and Monfalcone is characterized by two main seasons: winter, with catches dominated by spawning plaice (Platychthis flesus luscus), and spring with catches dominated by spawning cuttlefish (Sepia officinalis). Daily catch per boat can exceed 150 Kg. In the two eastern districts, particularly Trieste, for historical and geographical reasons, the small scale fishery outnumbers by size (GRT and HP) the trawl fleet.

Unfortunately in the period October-June in all the northern Adriatic (from Trieste to Rimini) bottom trawling is allowed in the coastal zone (up to 600 m from shore). In springtime the area is simply crowded by trawlers (Fiorentini et al., 1984) with consequent restriction of the surface available for trammel net fishermen.

3.2.2 Central Adriatic (Rimini, Ancona, S. Benedetto, Pescara)

In this area, as a result of bottom and fish communities characteristics, the number of boats operating fixed gears is considerably lower (Fig. 2), compared to the north.

Spring catch of spawning cuttlefish again represents a good percentage of the income of small scale fishery. But traps are used more than trammel nets. Unfortunately, due to insufficient patrolling, an intense illegal fishery with nets and traps by so-called "sport fishermen" has to be recorded in the whole area.

A specialized, mostly seasonal (October-May), fishery for Sphaeronassa mutabilis with traps developed considerably in the area in the last 15 years (Fabi and Giamini, 1983). Small baited traps are lowered on muddy sands (depth 8-12m) and checked daily. In the season the monthly catch per boat ranges between 2 and 5 tons.

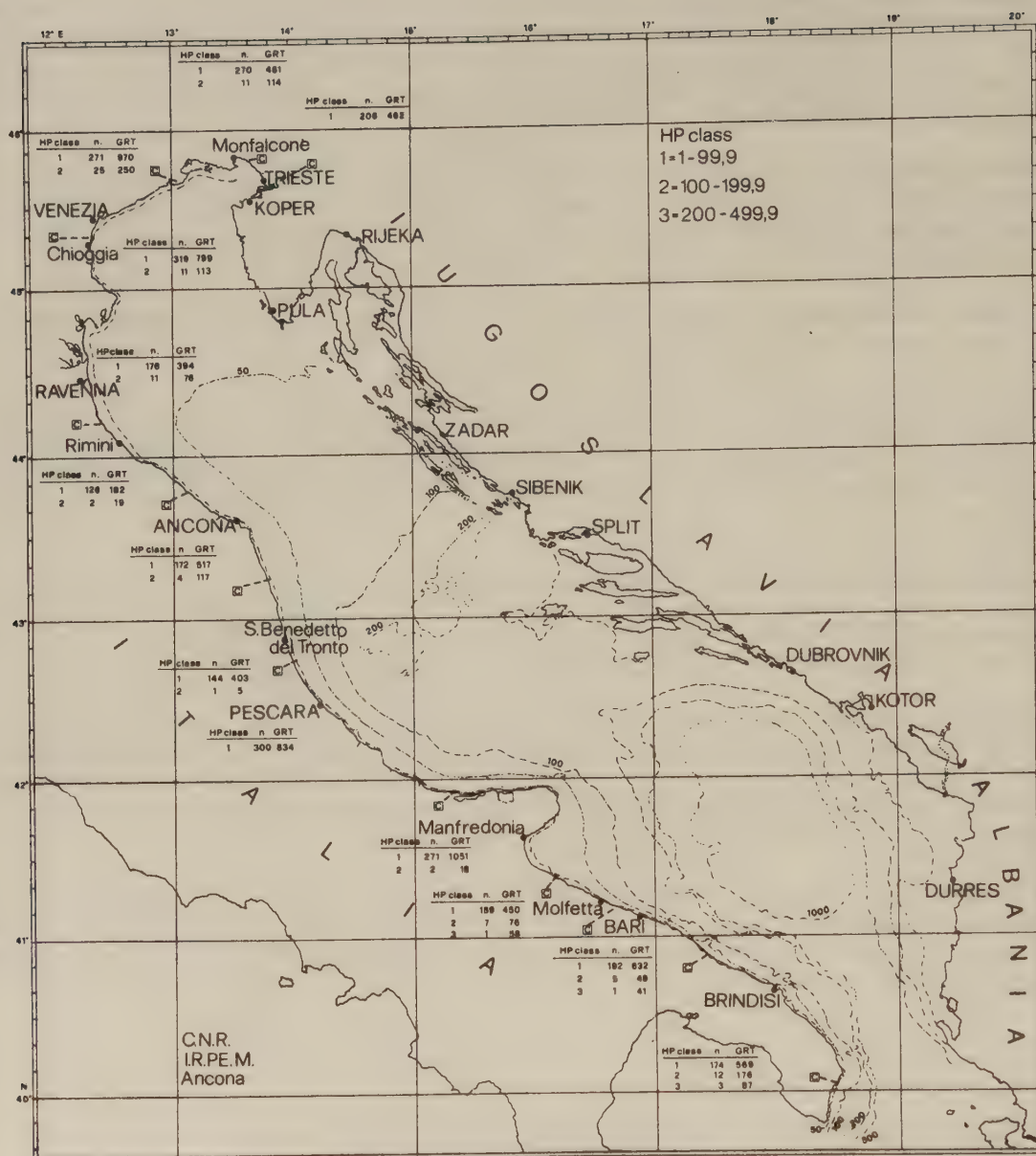


Fig. 2 - Fishing effort (Number of boats and total GRT) for small scale fishery along the Italian Adriatic coast.

3.2.3 Southern Adriatic (Manfredonia, Molfetta, Bari, Brindisi)

Presence of wide rocky areas and limited extension of trawlable grounds on continental shelf result in a higher importance of small scale fishery with fixed gears.

Hydraulic clam dredges are absent in Districts south of Molfetta.

In the last 15 years the discovery of open sea pelagic resources stimulated the development of a seasonal fishery with drifting long-lines, swordfish being the target species; Tuna, Prionace glauca and Ruvettus pretiosus are the most common accessory species.

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ANNEX (E) H

Preliminary considerations on the fishery management of the hake (*Merluccius merluccius* L.)
stock in the Adriatic Sea

by

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Quantitatively and economically the hake fishery is one of the most representative in the Adriatic. At the time of the third Consultation, the Marine Biology and Fisheries Laboratory of Fano, in collaboration with the Institute of Oceanography and Fisheries of Split, had carried out two seasonal trawl-surveys in the northern and central Adriatic excluding the Yugoslav territorial waters. Information relative to growth, mortality and distribution were given at the meeting and are included as annex L of the report of the third Consultation.

From that time, trawl surveys have continued to be carried out seasonally, not only in Italian and international waters but in spring 1983 and 1984 and in autumn 1984 (Pipeta cruises III, IV and V) also in Yugoslav waters, covering a wider area of the distribution of stocks. The surveys have been carried out by the same vessel under constant methodology and gear. Results of six surveys are now available: 4 relative to spring and 2 to autumn, 3 of them covering the whole north and central Adriatic with the only exception of the channel regions of Yugoslavia.

Present data confirm the distribution pattern of the species as it was shown by Zupanović (1968) and Flamigni (1983); they underline the existence of zones characterized by different length frequency distributions due to spawning and trophic migrations, mainly between the deepest and the shallowest waters of the central Adriatic. The constant absence of the hake north of the Po river delta is also confirmed.

In order to investigate the dynamics of the stock in a simple and analytical way, we have considered as a first step the length frequency distributions of the different surveys standardizing per unit of fishing time and weighing per area every length class. The weighted length frequency distributions are shown in Fig. 1. In this way they are directly comparable and on the assumption that they represent the population, the absolute number of fish is reported. Actually that number is not absolute since we are not taking into account the catchability coefficients. We can note the variability of the influence of recruits and the importance of the part of stock living in Yugoslav waters.

As a next step we have determined age-length keys for every survey by reading otoliths of subsampled hakes in the laboratory. The number of aged fish has ranged from 484 to 780 for the different surveys. The age-classes were determined by the number of rings on the otoliths due to the long spawning season that makes difficult the determination of a birthdate. Every number of fish of the corresponding length-class has then been assigned to an age-class according to the age-length key specific of that survey. In Fig. 2 the age frequency distributions for the different surveys are shown. The shaded areas are relative to Yugoslav waters showing the quantitative influence of that zone especially on age-classes older than 1 year. It is important to remember also that the age class 0, and to a minor extent part of class 1, are not fully recruited to the gear.

At this point remarkable progress can be obtained in matters of determination of total instantaneous mortality rates (Z) since we are able to calculate it directly on age classes between surveys and also to follow some cohort avoiding possible bias due to variability in recruitment. In addition, using the catch of a specially chartered commercial fishing boat is closer to reality since it is not affected by the effects of discarded fish, as happens when

landed catches are analyzed.

In table 1 we have a summary of the Z calculated both with data from one survey (assuming equilibrium) and by comparing abundance changes between successive surveys in Italian and international waters. A general decrease in the Z values is evident from the first age classes to the oldest ones with a small increase on the third class. There are similar mean Z in and between surveys denoting on the average of these 6 surveys a rather stable situation after class 1. Since age class 5 is inclusive of all elder fish Z for age class 4 has been determined by an alternative method. From the available 6 surveys it is also possible to completely follow at least one cohort, namely the class 1 in spring 1982 up to class 4 in spring 1985. Those mean Z are very similar to the values obtained both in and between surveys. Similar Z values were also obtained using the catch curves method. These agreements show that the assumptions of equilibrium (constant F and constant R) are not greatly violated.

In order to fix mean Z for different age classes we have analyzed (table 2) 4 consecutive spring surveys. The mean values between surveys were used for the following computations relatively to Italian and international waters.

In table 3 we have the 3 surveys covering not only Italian and international waters but also Yugoslav waters and have determined mean Z for this wider area. In spite of the reduced number of surveys remarkable differences with the previous cases appear. A more marked decrease in Z at age class 2 is clear, while in general we have lower mean values for Z. Different fishing mortality rates (per age class) and perhaps possible migrations in the channels should be responsible for the apparent discrepancy. This result shows the importance of covering the whole distribution area of the stock under investigation for mortality estimates.

In order to make evident the importance of including Yugoslav waters for a more complete and correct understanding of the stock we have made a simulation graphically represented in figure 3 (using a Thompson and Bell yield per recruit model). In this example we have considered a starting stock of one million hakes at a length of 14 cm (Lc). Applying the relative age class Z, as determined before and weighted according to age-length key for every length-class, we have determined the survival curve for 2 different values of Z, namely the values obtained for the Italian plus international waters and the value obtained for the "total" area. Combining these data with the length-weight curve we have obtained fig. 3 representing biomass of a cohort of hake at different sizes. We do not consider fish longer than 50 cm since they are only caught occasionally, due mainly to their low vulnerability to the gear. Figure 3 shows a remarkable difference in biomass due to the different Z used in the 2 cases. Another important point is the shift of the size that gives the maximum biomass from 22 to 28 cm which could have different management implications for the same stock.

In order to evaluate the effects of different management interventions, we have constructed another simulation graphically represented in Fig. 4. This case is relative to Italian and international waters and here we assume a constant fishing mortality on all the length classes from 14 to 50 cm. Applying the relative Z value to every length class, as has been done in the previous case, and considering a recruitment of one million fish at a length of 14 cm we calculated the biomass and the yield in weight for different fishing mortality rates. The value in Italian lire of the landings, considering the different gross market values per length class is also shown. The method we have used is summarized by the following formulae:

$$\text{Biomass} = B_1 = \sum_{i=2}^{n=L} \sum_{m+j}^{\max} N_{i-j} \cdot e^{-\bar{Z}_{i-j,i} (t_i - t_{i-j})} \cdot W_i$$

$$\text{Catch} = Y = \sum_{i=2}^{n=L} \sum_{m+j}^{\max} \left[N_{i-j} - N_{i-j} \cdot e^{-\bar{Z}_{i-j,i} (t_i - t_{i-j})} \right] \cdot \bar{E}_{i-j,i} \cdot \bar{W}_{i-j,i}$$

On the other hand, we looked into the case where F is fixed (for the present state of the fishery, it has been chosen as equal to 0.8) and the size at first capture is changed. In this simulation, shown in Fig. 5, we start with one million fish at a length of 8 cm and in a way similar to the previous one we have determined the same curves as before at the various L_c . As was already assumed at the third Consultation, an increase in L_c produces a steady increase of the biomasses. For example, a 25% increase in the catch while having a theoretical increase of the same order acting only on L_c it is sufficient to increase L_c from 14 to about 16 cm. Economically we have a similar situation regarding those changes of F and L_c .

From a socio-economic point of view also, it might be more convenient to act on L_c than on F . This could mean an increase in the trawl-net mesh as the most direct measure. This measure has not only a direct cost but also a major indirect one due to the loss in catch of other species, which have different selection factors, in a multispecific fishery like the Adriatic demersal one. An alternative measure in this direction could be to act not only or exclusively on the mesh size, but also on the geographic distribution of the fishing effort since a different geographic size distribution of the hake in the Adriatic has been shown in relation to the existence of specific nursery areas.

This could mean the banning or limiting of trawl-fishery on the known nursery grounds, corresponding to some deep central and southern Adriatic areas, losing a part of the catch previously made or old spawning year classes, but waiting for the young after their migration to shallower waters, at a size highly-appreciated on the market.

In this way fishing on nursery areas with gears, characterized by better selectivity, e.g. with bottom long-lines, could be highly recommended.

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Class	Spring '82		Autumn '82		Spring '83		Spring '84		Autumn '84		Spring '85
1	1.35	2.53	.14	.28	1.33	2.13	1.55	.16	.87	1.34	1.78
2	.66	.1	1.18	1.84	.91	1.18	.38	(-)	.81	1.10	.75
3	1.08	1.14	1.23	1.97	1.24	.94	.67	(-)	1.05	1.93	1.22
4	.98*	1.43	1.27*	.60*	.72*	.73*	.91*	.42	.75*	1.09*	1.15*
$\bar{Z}$	1.02	1.3	.96	1.17	1.05	1.24	.88	x	.87	1.37	1.23

Table 1: Total instantaneous mortality rate per age-class (all Pipeta surveys): Italian and international waters).

* Estimated by Heincke's method.

Class	1982	1983	1984	1985	$\bar{Z}$
1	1.41	2.13	.75		1.43
2	.97	1.18	(-)		1.08
3	1.55	.93	.79		1.09
4	.99*	.73*	1.24*		.99*
$\bar{Z}$	1.23	1.24	.93		1.15 1.13

Table 2 : Total instantaneous mortality rate per age-class (spring Pipeta surveys).

*Estimated by Heincke's method.

Class	Spring '83		Spring '84		Autumn '84	$\bar{Z}$ in	$\bar{Z}$ between
1	1.33	1.65	1.01	.12	.68	1.01	.89
2	.26	.23	(-)	(-)	.51	.39	/
3	1.09	1.13	1.17	.65	.88	1.05	.89
4	.94*	1.24*	1.21*	.07	1.32*	1.16	.66
$\bar{Z}$	.91	1.06	1.13	.28	.85	.90 .96	.81 .67

Table 3 - Total instantaneous mortality rate per age-class (Pipeta surveys: Italian, international and Yugoslav waters).

* Estimated by Heincke's method.

Italian + International Waters

Total

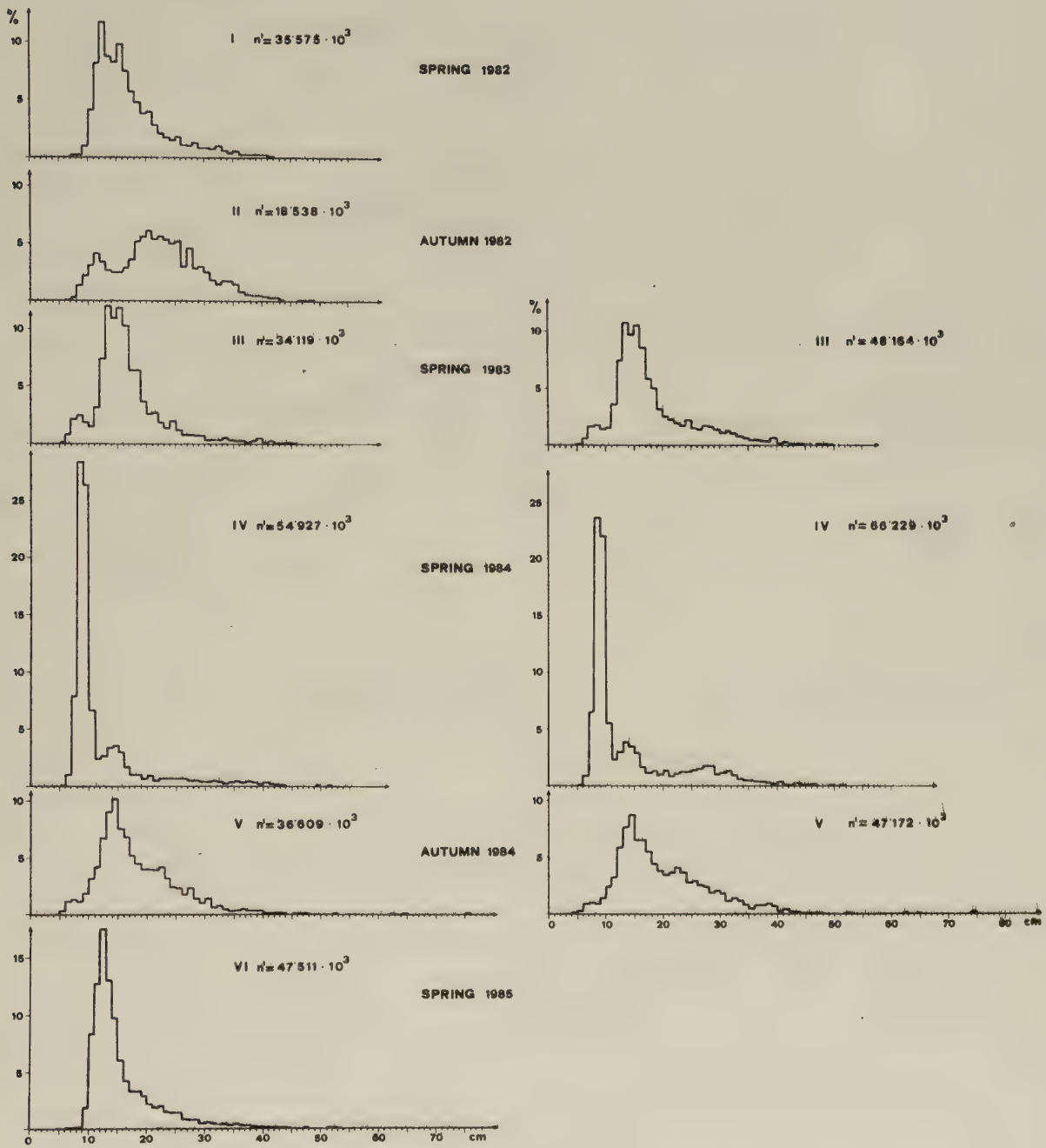


Fig. 1: Standardized and weighted hake length frequency distribution for the six PIPETA trawl surveys.

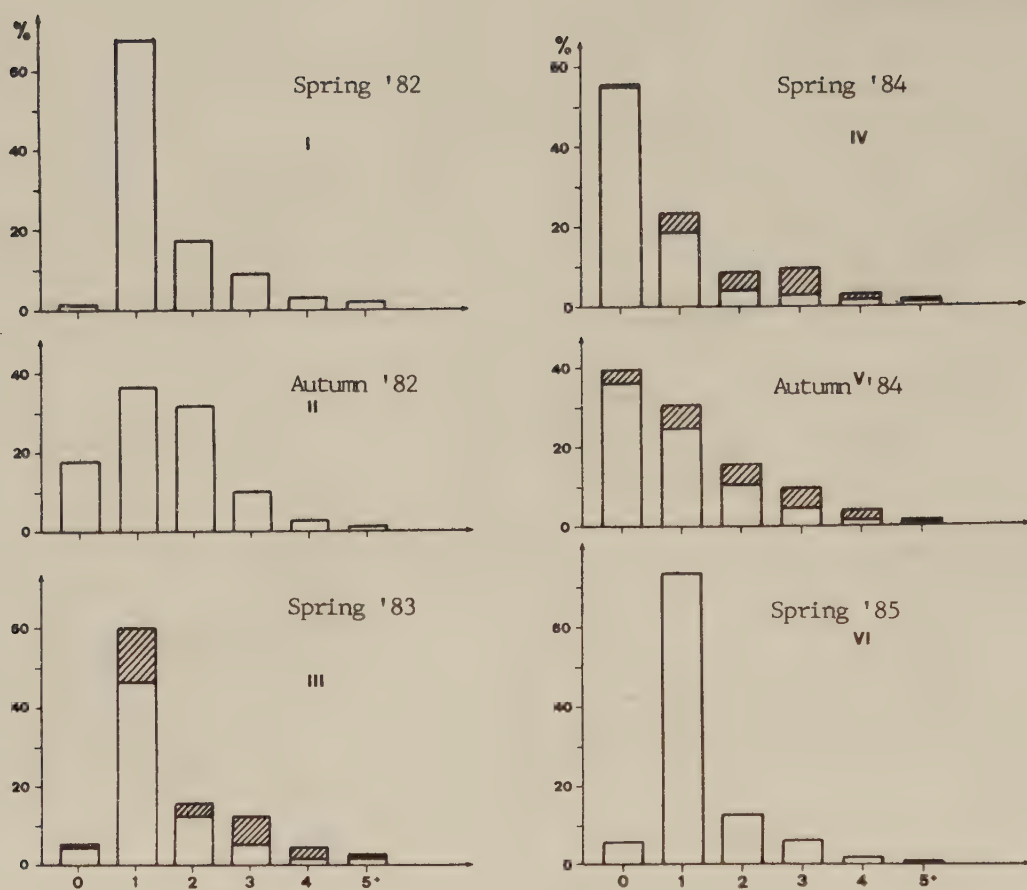


Fig. 2 - Age frequency distribution for the six surveys.
(the hatched portion corresponds to the fish in the Yugoslav waters.)

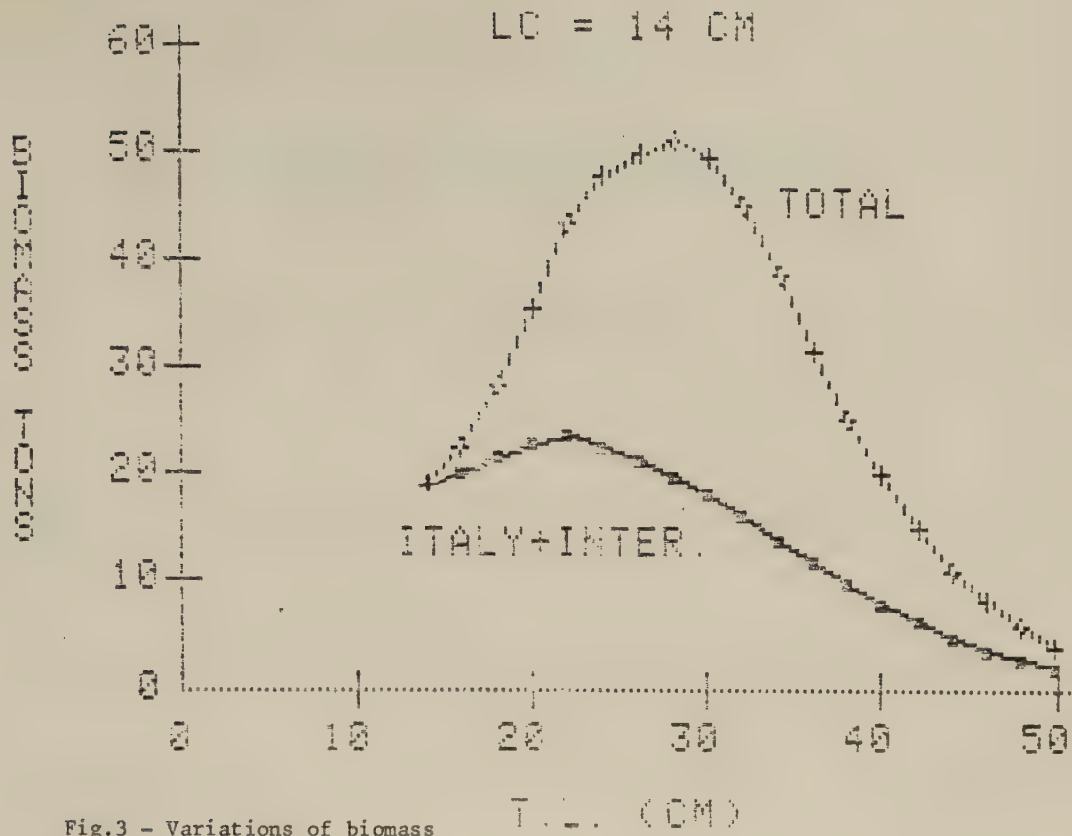


Fig.3 - Variations of biomass with length.

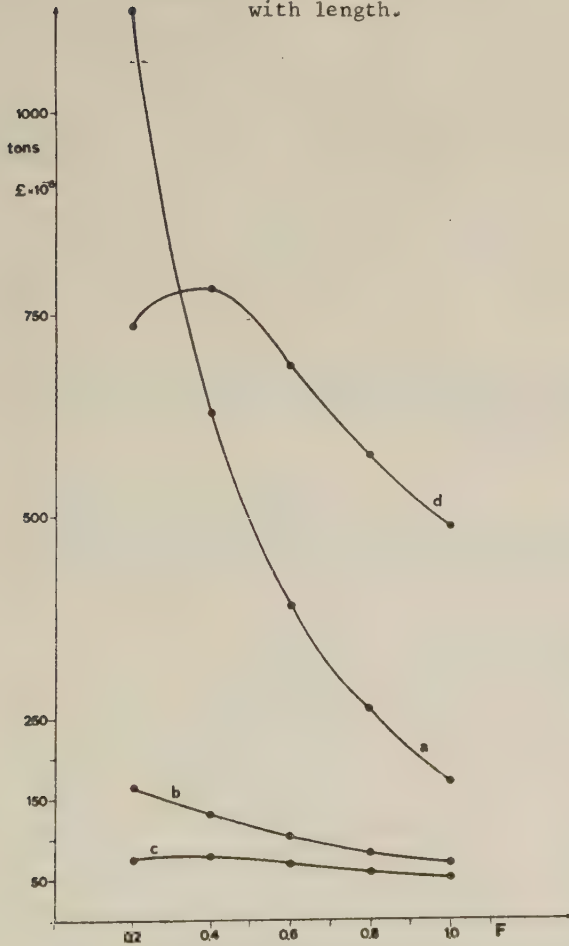


Fig. 4 - Simulation of variable F.

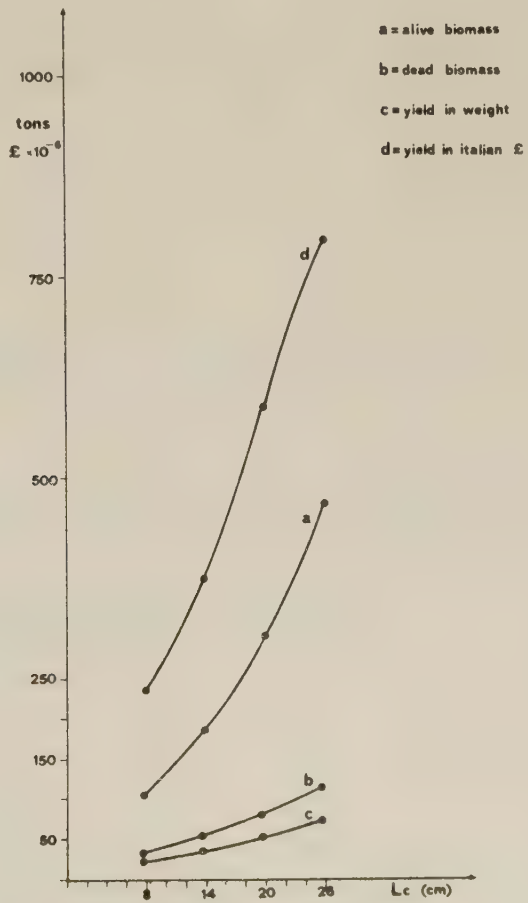


Fig. 5: Simulation of fixed F.

ANNEX (E) I

Some preliminary observations on the biology and dynamics of
Mullus barbatus L. in the Adriatic Sea

by

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1. Introduction

M. barbatus is a very important fish in Adriatic demersal fishing, both for its abundance and for its economic value. Its particular life cycle with a large concentration of juveniles in the shallow waters along the Italian coast in summer, and in autumn a migration towards deeper waters attracts the attention of fishery researchers.

After the second World War Scaccini (1947) started to study this fish in the Marine Biology Laboratory of Fano, but also in Split many researchers (Bougis and Muzinić 1958, Zupanović 1961, Haidar 1970, Jukić 1972) devoted their attention to its biology and dynamics.

This paper shows some results obtained from "Pipeta" experimental trawl surveys which have been carried out since May 1982, once or twice a year, in a cooperative programme between the Fishery Laboratories of Split and Fano.

2. Material and Methods

Six experimental trawl-surveys with the commercial vessel "Pipeta" of 300 H.P. have been carried out in the northern and central parts of the Adriatic: stations were situated on transects going from the Italian to the Yugoslav coasts.

Four surveys were carried out in spring (1982, 83, 84 and 85) and two in autumn (1982 and 84); in the springs of 1983 and 1984 and in the autumn of 1984, the Pipeta was allowed to conduct fishing operations inside the Yugoslav territorial waters and so it was possible to sample a wider area.

At each station trawling operations were performed for about three hours; the total weight and the distribution length of the catch of M. barbatus were recorded and a subsample of 20 individuals was collected when the catch was big enough for biological investigation.

3. Results and Discussion

Weighing our average density index (kg/h) for the investigated area, we obtained relative total biomass values for each survey. These values (in tons) are given in the following table:

Period	Biomass Index	
	Italy and International	Yugoslavia
May 1982	502	-
Nov 1982	3290	-
May 1983	554	2297
May 1984	504	2680
Nov 1984	925	3138
May 1985	444	

We did the same with the average number of fish caught in one hour to obtain an index of population size in number ($N \cdot 10^3$). The values are given in the following table:

Period	Population size index (Nb)	
	Italy and International	Yugoslavia
May 1982	17337	-
Nov 1982	114467	-
May 1983	17435	103983
May 1984	15915	73057
Nov 1984	34137	121886
May 1985	12110	-

Mullus barbatus is found in the whole northern and central Adriatic (Jukić, Arneri 1983), but the quantities in the various zones differ according to the seasons. Figures 1 and 2 show that in the Yugoslav territorial waters it is always very abundant, but in the international and Italian waters the pattern of abundance varies with the season. In spring Mullus barbatus is found mainly in the eastern part, on sandy bottoms; in autumn it is found all over the Adriatic continental shelf.

We also weighed our length frequency distributions of the catches to obtain a total length frequency distribution that we may assume to be representative of the population of Mullus barbatus in the investigated area (Fig. 3).

By means of scales reading for age determination, we constructed five age|length keys, and with the average values obtained from previous spring surveys (I, III, IV) we obtained the sixth key (spring 1985) because data were not yet available. In table 1 an age|length key (spring 1984) is shown.

With these age|length keys it has been possible to pass from a length to an age distribution for each survey (fig. 4).

The Italian and international waters have been kept separate from the Yugoslav territorial waters because of the big difference in fishing effort in the two areas. In spring surveys I, III, IV, VI, the age distribution appears to be rather constant from year to year; but in autumn surveys II and V the variability of recruitment is very important: in number class 0 is more than 60% in autumn 1984 and more than 90% in autumn 1982, which was a very good year for M. barbatus recruitment near the Italian shore.

To analyse the concentration of young M. barbatus in autumn, we observed the age distribution of the stations near the Italian and Yugoslav coasts (Fig. 5); we obtained two very different age distributions; near the Italian shore class 0 is almost the only component of the catches.

We also noted that age distribution is not the same from north to south.

We divided the investigated area (Italian and international) into three zones (north, central, south) and their respective age distribution for three different spring surveys (I, III, IV) are shown in Fig. 6: in the northern part one year old individuals are prevailing while in the "southern" area we found older individuals. This area is deeper than the others and that might explain the dominance of older individuals.

Using the number of individuals at every age class we calculated some instantaneous total mortality rates (Z) following the decrease in number of the age class from one survey to the next one (table 2). The values relating to the whole area (Italian and international and Yugoslav) are shown separately, but are very similar. These values are rather constant in the various years and

probably they can be considered as a rough estimation of instantaneous mortality rates of the population from the second year of life onwards, that is to say from class one.

We also calculated values of Z from autumn to the following spring (from age 0 to age 1) and found very different values:

$$1982/83 \quad Z = 4.37 ; \quad 1984/85 \quad Z = 2.47$$

These values are related to big fluctuations in recruitment as shown in the biomass index for the two autumns (1982 = 3290 tons; 1984 = 925 tons). These differences could be related to differences in fishing and/or natural mortality related to abundance. The high Z values can be explained with a migration of young M. barbatus towards the eastern part of the Adriatic and with the different fishing effort that they must undergo in their first year of life.

4. Conclusions

The great difference in biomass index between the Italian and Yugoslav waters (about 1:4) shows that it is necessary to cover the whole area with sampling. The difference in distribution of young individuals compared to other age classes suggests that autumn surveys, if repeated yearly, could provide an index of recruitment. From the end of the first year of life the population has rather constant parameters as the instantaneous mortality rates and the biomass index; therefore both the investigation and the management should be conducted in cooperation between the two countries concerned. Hopefully the investigated area should be expanded to cover the region of the Dalmatian channels, to detect its contribution to the recruitment of M. barbatus, and its input and output towards the off-shore Adriatic as Zupanović suggested in 1961.

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Table 1: Age|length key of M. barbatus, Spring 1984

LT	1	2	3	4	5	AGE
7	2					
8	2					
9	1					
10	7					
11	16					
12	17	1				
13	36	5				
14	21	25				
15	16	32	1			
16	4	28	2			
17	1	13	11	1		
18	0	8	7	0		
19	0	2	5	3	1	
20	0	1	4	5	1	
21	0	0	0	1	2	
22	0	0	1	0	1	
	N = 123	N = 119	N = 31	N = 10	N = 6	

Table 2 - Instantaneous mortality rate of M. barbatus

A) Italian and international waters

	Age Class			$\bar{Z}$
	I-II	II-III	III-IV	
82-83	0.88	1.94	1.94	1.59
83-84	0.89	2.02	1.99	1.63
84-85	0.87	1.73	1.75	1.45
$\bar{Z}$	0.88	1.90	1.89	

B) Italian + International + Yugoslav Waters

	I-II	II-III	III-IV	$\bar{Z}$
83-84	0.99	2.06	1.87	1.64



fig.2- Distribution of abundance
of M. barbatus from autumn
surveys data



fig.1- Distribution of abundance
of M. barbatus from spring
surveys data



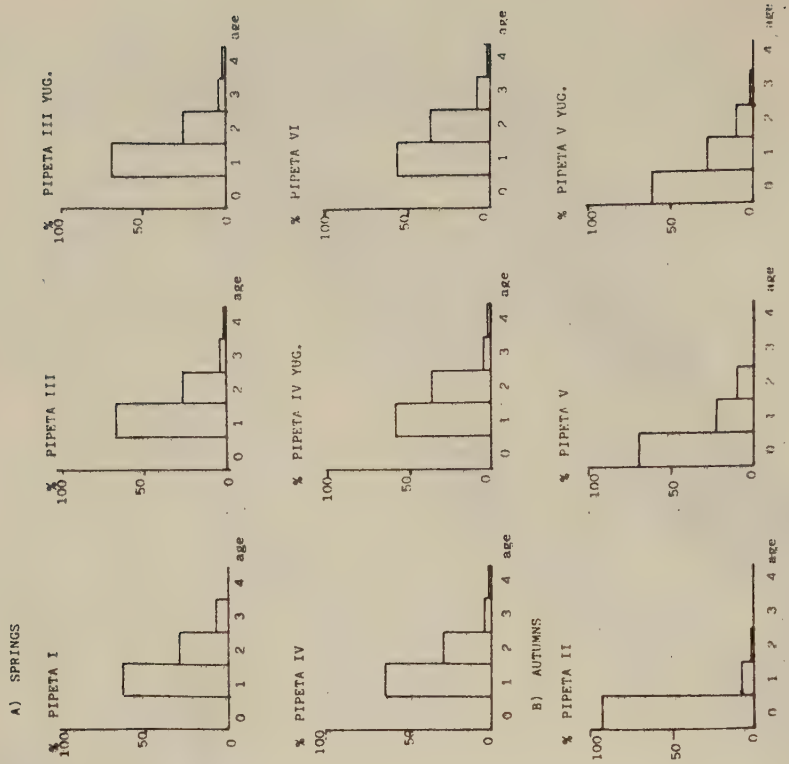


Fig. 4 - Age distribution of *M. barbatus* from Pipeta surveys.

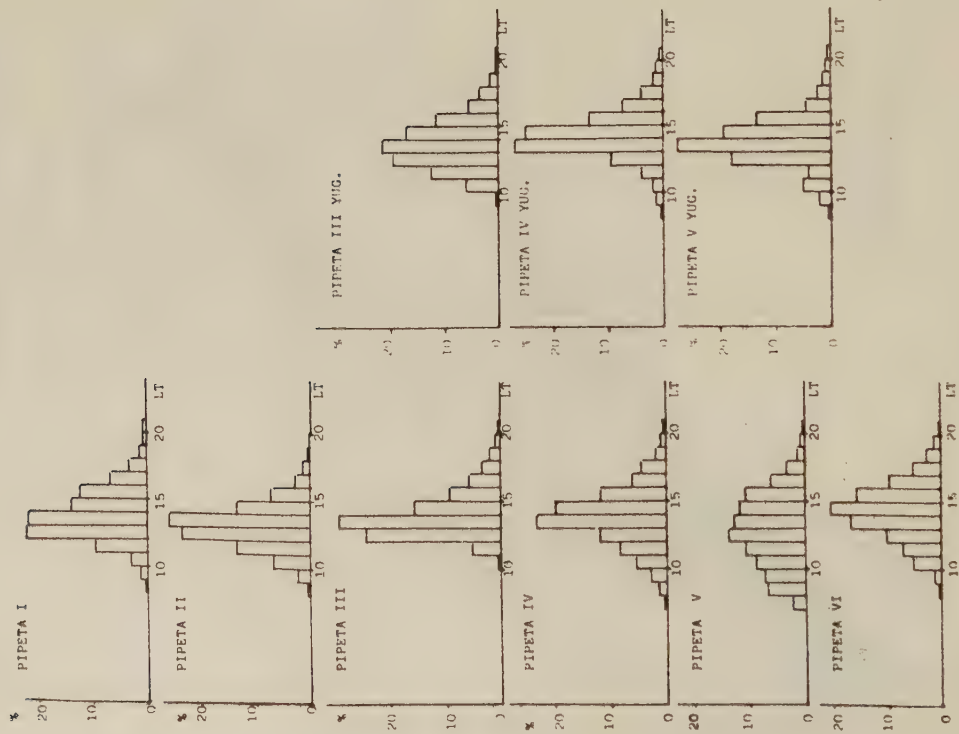


Fig. 3 - Length frequency distribution of *M. barbatus* from Pipeta surveys.

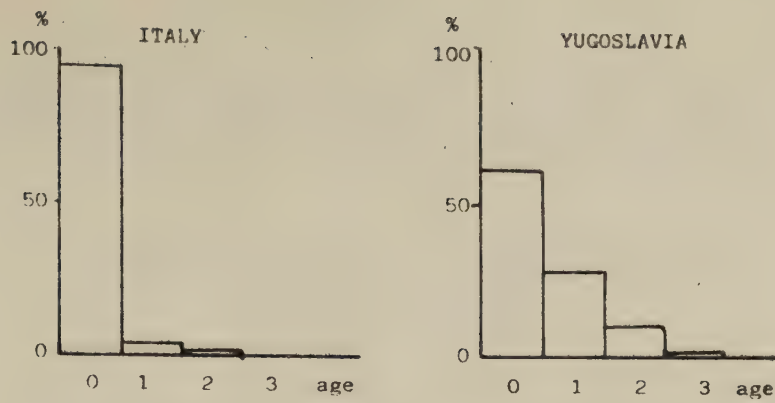


Fig 5 - Age distribution of *M. barbatus* along the Italian and Yugoslav coasts: Autumn 1984

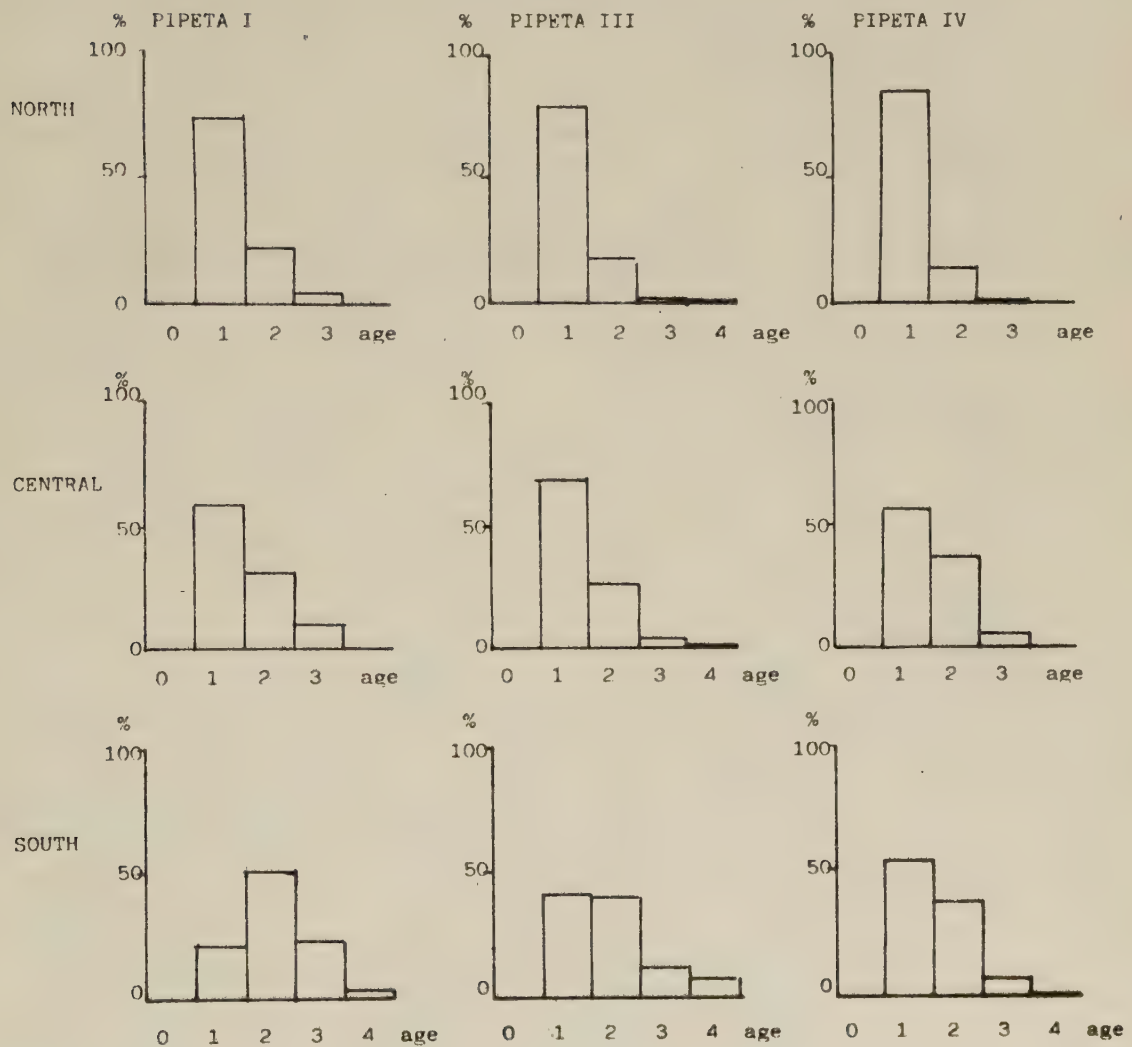


Fig. 6 - Age distribution of *M. barbatus* from North to South in the investigated area (Springs 1982, 1983, 1984)

ANNEX (E) J

Preliminary utilization of trawl survey data for hake (*M. merluccius*)
population dynamics from the Western Greek waters

by

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1. Introduction

Information on the distribution, fisheries biology and stock size of *Merluccius merluccius* L., in the western Greek seas (Ionian Sea, Patraikos and Korinthiakos Gulfs) have been collected during four seasonal trawl surveys (June 1983 - March 1984), by the Fisheries Laboratory of the National Center for Marine Research, Athens. The sampling stations (Fig. 1) were selected on the basis of the nature of the substrate, the depth and the fishing activity in the area.

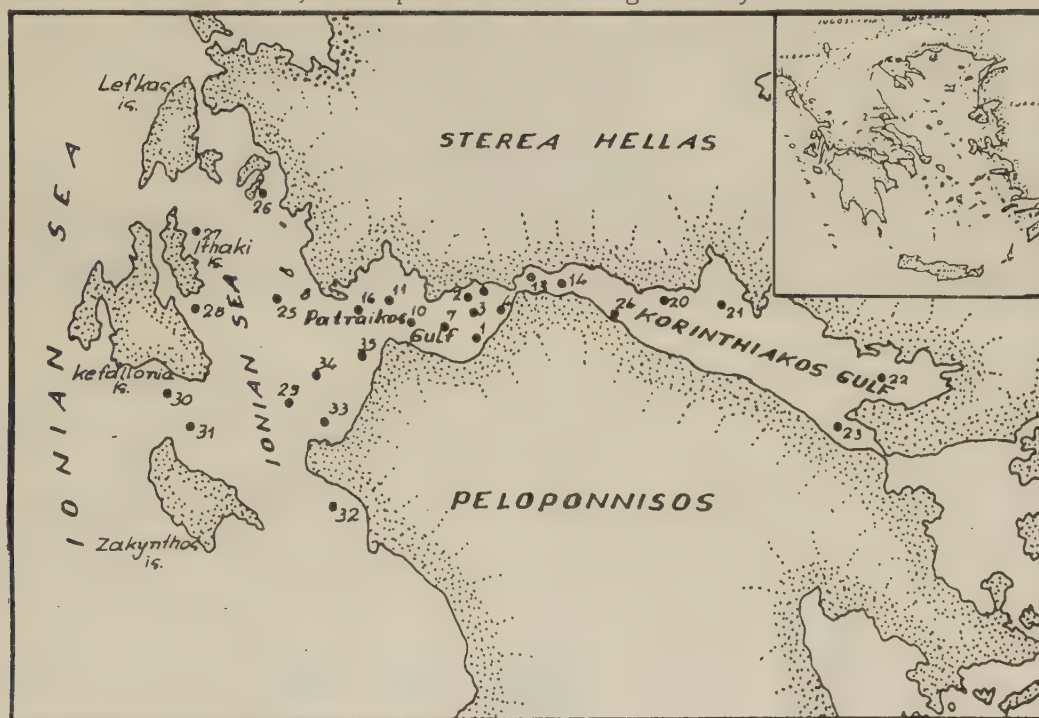


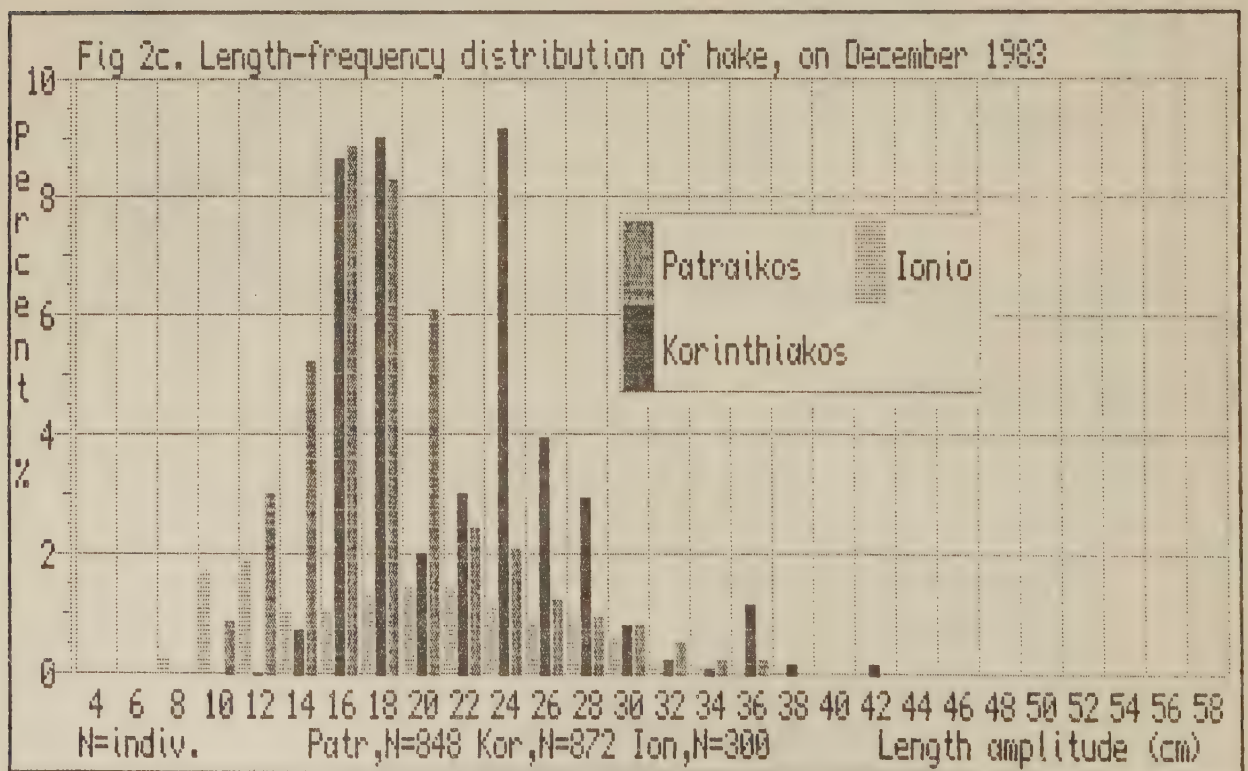
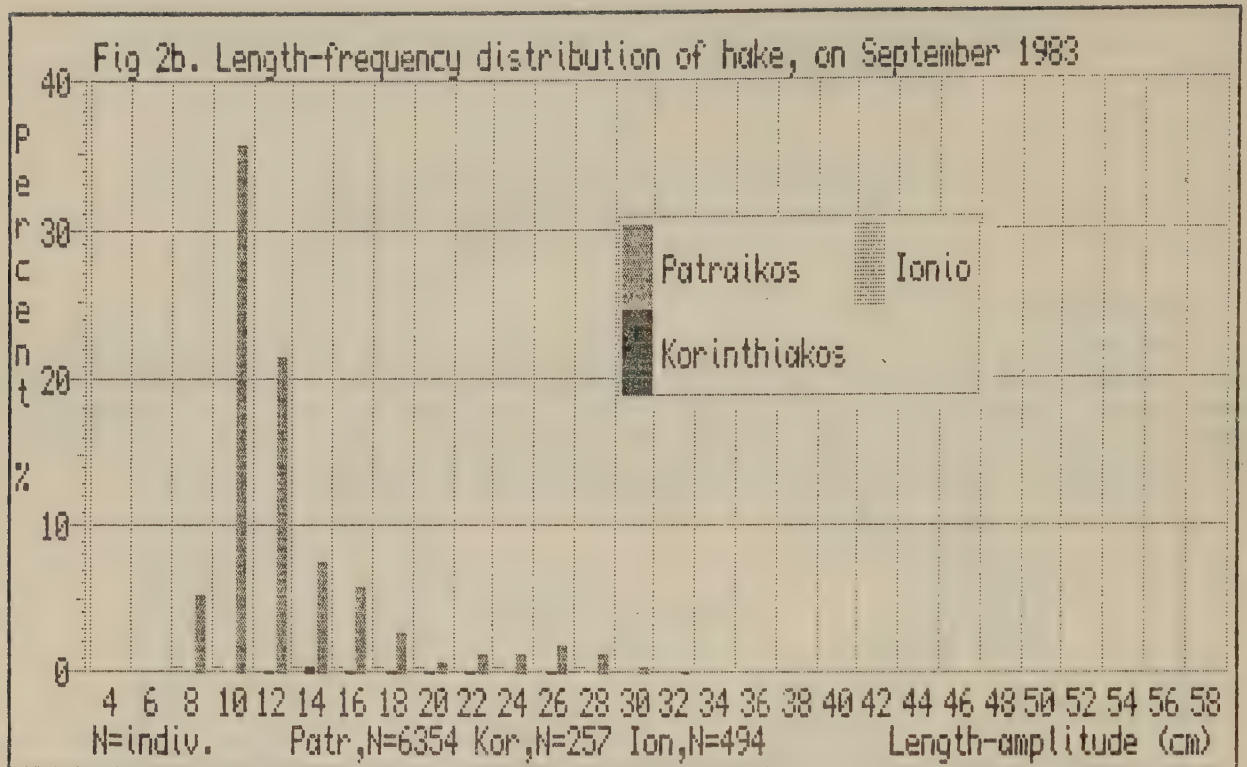
Fig. 1 - Sampling Stations.

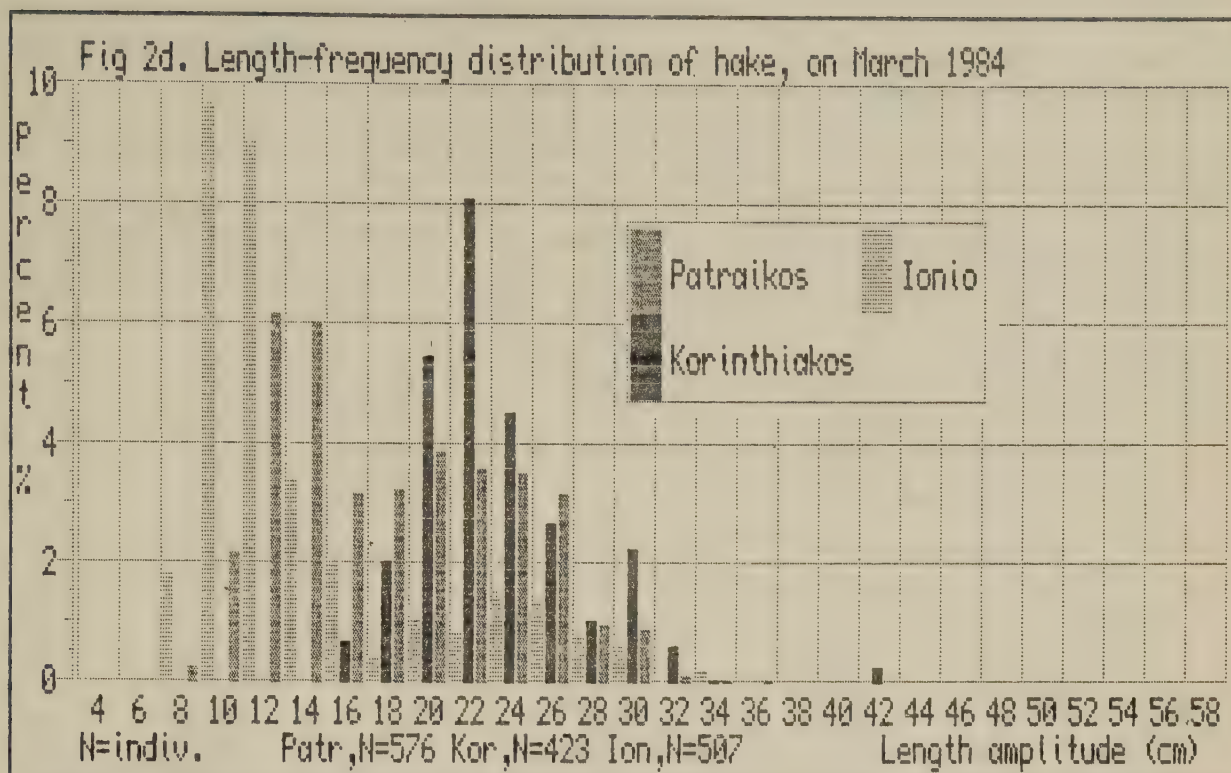
2. Length/Weight Relationships

Table 1 shows the predictive length/weight relationship per study area.

Area	a	b	c
Patraikos Gulf	2×10^{-6}	3.2246	0.96
Korinthiakos Gulf	1×10^{-6}	3.2006	0.97
Ionian Sea	3×10^{-6}	3.1957	0.97

Table 1 - Length/weight relationship parameters.
($W = a \times L^b$ where W in g and L in mm)





As can be seen from the length-frequency distribution, the young-of-the-year appear as recruits in the Patraikos Gulf between June and December (with a peak in September), and between December and June in the Ionian Sea (with a peak in March).

The hake populations in the Patraikos and Korinthiakos Gulfs and the Ionian Sea are mainly composed of young individuals smaller on the average than 180 mm (77%, 20% and 59.5% respectively). Individuals with a length ranging between 180 to 300 mm accounted for 20%, 69.5% and 34.5% respectively, whereas those with a length greater than 300 mm for 3%, 20.5% and 6%.

The fact that hake spawns for the first time at the age of three years (Papaconstantinou *et al.*, 1978), indicates that the need for taking fishing measures for a rational management of the hake stocks in that area exists.

The sharp decline of the 0-group hake density in the Patraikos Gulf between September and December may be attributed to a displacement of the stock from Patraikos to either Korinthiakos Gulf of the Ionian Sea, and to natural and fishing mortality.

In the Patraikos Gulf, the hake recruitment takes place at depths greater than 50 m., with a maximum at the depth of 110 m., while in the Ionian Sea the recruits of hake (70-80 mm) appear at a depth of about 300 m.

From all the above, it is inferred that two independent hake populations exist in the study area, namely, one in the Ionian Sea and another in the Patraikos Gulf. Considering also that Korinthiakos is a deep closed gulf with a restricted continental shelf, it may be assumed that a third hake population exists there.

3. Growth

The age of the hake was determined by means of otholith readings. Consequently, these data were used for the computation of growth parameters on a three month basis.

Although the 0-group recruitment was not complete, it was used for the computation of biological parameters because of its high abundance during the studied period.

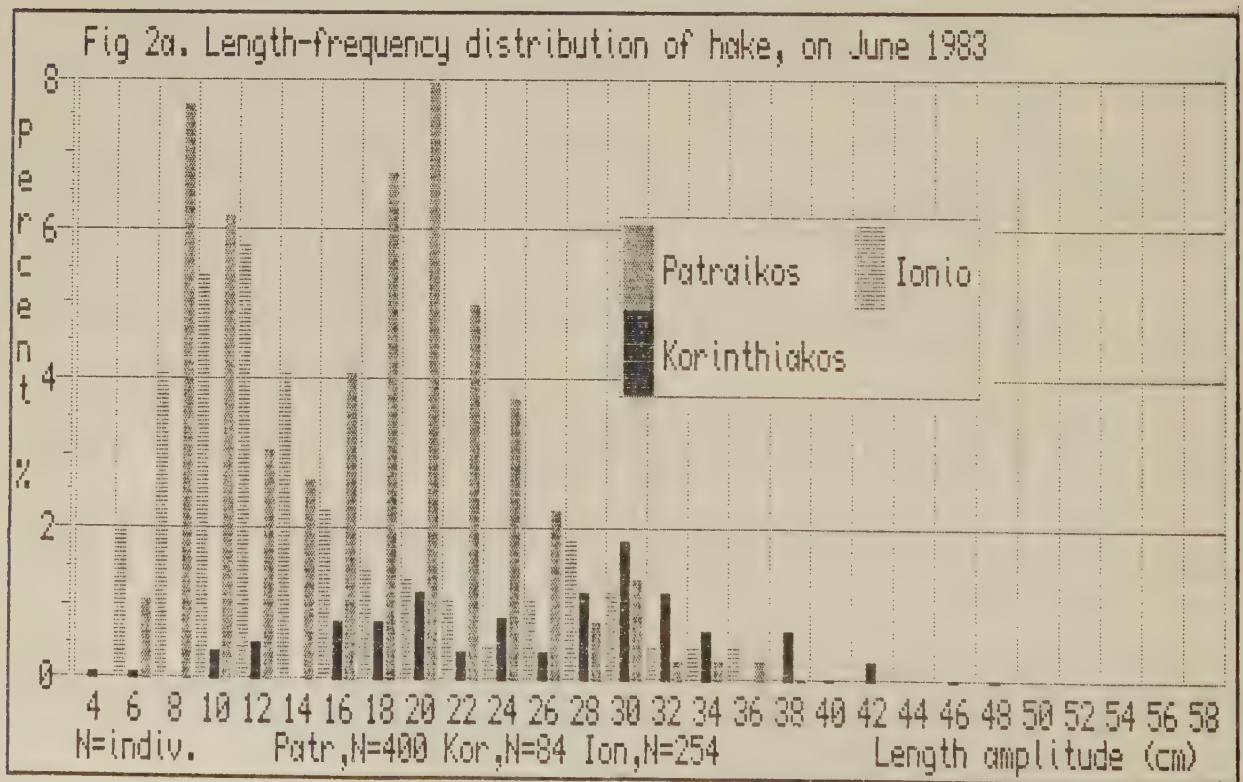
Table 2 shows the growth parameters for each area, derived from the von Bertalanffy equation.

Area	L _∞ (Cm)	K
Patraikos Gulf	63.8	0.0751
Korinthiakos Gulf	65.9	0.0681
Ionian Sea	71.7	0.0809
Total Area	64.2	0.0701

Table 2 - Growth parameters of the von Bertalanffy equation.

4. Length Frequency distributions

Figures 2a to 2d show length-frequency distribution of hake per geographic area.



5. Mortality

The mortality was calculated by means of the Pauly's length converted catch curve method (1980); this method implies the hypothesis of constant recruitment, so it should be checked on a multi-year basis (Table 3).

TABLE 3.-Data for the construction of a catch curve for the hake from the Patraikos-Korinthiakos Gulf and Ionian Sea (total area)

Class	limits	mid-range	N	$t_1/2$	$t_2/2$	D_t	adjusted number per length : class $\log_e D_t$	mean relative age	Remarks
lower	Upper								
4.00	- 5.99	5	1	0.920	1.399	0.479	0.730	1.159	not used : ascending part of the curve:
6.00	- 7.99	7	30	1.400	1.899	0.499	4.097	1.649	
8.00	- 9.99	9	567	1.899	2.415	0.516	7.000	2.157	
10.00	- 11.99	11	2939	2.415	2.952	0.537	8.609	2.684	portion used for: estimating Z
12.00	- 13.99	13	2028	2.952	3.509	0.557	8.199	3.230	
14.00	- 15.99	15	1004	3.509	4.089	0.580	7.457	3.799	
16.00	- 17.99	17	1018	4.089	4.694	0.605	7.429	4.391	
18.00	- 19.99	19	819	4.694	5.325	0.631	7.168	5.009	
20.00	- 21.99	21	567	5.325	5.985	0.660	6.755	5.655	
22.00	- 23.99	23	561	5.985	6.678	0.690	6.697	6.332	
24.00	- 25.99	25	611	6.678	7.406	0.728	6.733	7.042	
26.00	- 27.99	27	453	7.406	8.173	0.767	6.381	7.790	
28.00	- 29.99	29	333	8.173	8.984	0.811	6.018	8.579	
30.00	- 31.99	31	203	8.984	9.844	0.860	5.464	9.414	
32.00	- 33.99	33	73	9.844	10.758	0.914	4.380	10.301	
34.00	- 35.99	35	52	10.758	11.736	0.978	3.974	11.247	
36.00	- 37.99	37	59	11.736	12.785	1.049	4.029	12.261	
38.00	- 39.99	39	21	12.785	13.918	1.133	2.920	13.352	
40.00	- 41.99	41	8	13.918	15.149	1.231	1.872	14.533	
42.00	- 43.99	43	12	15.149	16.495	1.346	2.187	15.822	
44.00	- 45.99	45	7	16.495	17.983	1.488	1.549	17.239	
46.00	- 47.99	47	1	17.983	19.643	1.660	-0.507	18.813	
48.00	- 49.99	49	6	19.643	21.523	1.880	1.161	20.583	not used, close to L_{∞}
50.00	- 51.99	51	2	21.523	23.683	2.160	-0.080	22.606	

1/ fork length in cm

2/ computed by means of the equation, $t-t_0 = \log_e(1 - l_t/l_{\infty})/(-k)$ with $t_0 = 0$.

The total mortality coefficient Z for each marine region (table 4) was calculated. Our value, $Z = 0.72$, can be compared with those estimated by Zupanović (1968), $Z = 0.68$.

Table 4 - Total mortality coefficient (Z), fishing mortality (F), natural mortality (M) and exploitation rate (E) per area.

Area	Z	F	M	E
Patraikos Gulf	0.724	0.524	0.20	0.72
Korinthiakos Gulf	0.753	0.573	0.18	0.76
Ionian Sea	0.709	0.519	0.19	0.73
Total area	0.720	0.530	0.19	0.74

The natural mortality (M) was calculated according to Pauly's method (Pauly, 1980), based on the estimation of L_{∞} , K and T (mean environmental temperature) and was found to be $M = 0.19$.

The exploitation rate (E), calculated according to the formula: $E = F / (F + M)$, was found to be rather high ($E = 0.74$), indicating that the hake stock in the study area is heavily overfished, as it is usually assumed that the stock is fully fished when $M = F$ and $E = 0.50$.

6. References

Flamigni, C., 1983: Preliminary utilization of trawl survey data for hake (Merluccius merluccius L.) population dynamics in the Adriatic Sea. FAO Fish. Rep. (290): 109 - 115.

Pauly, D., 1980: A selection of simple methods for the assessment of tropical fish stocks. FAO. Fish. Circ. (729): 54p.

Papaconstantinou, C., Tsimenidis, N., Daoulas, Ch., 1978: Age and growth studies of the hake (M. merluccius) in the Saronikos and Thermaikos Gulfs. Thalassographica, 2(1): 27-56 (in Greek).

Zupanović, S., 1968: Study of hake (Merluccius merluccius) biology and population dynamics in the central Adriatic. Stud. Rev. GFCM (32) : 24p.

Résumé des paramètres biologiques du rouget (*Mullus barbatus*) des côtes occidentales grecques

par

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1. Introduction

Les données de quatre campagnes de pêche au chalut ont été collectées et traitées au laboratoire des pêches maritimes du Centre national pour les Recherches marines d'Athènes (CNRM).

Les stations d'échantillonnage ont été choisies en se basant sur la nature du substrat, la variation spatiale de la profondeur et l'activité de pêche qui existe dans la région échantillonnée (Golfe Patraikos, golfe Korinthiakos et mer Ionienne).

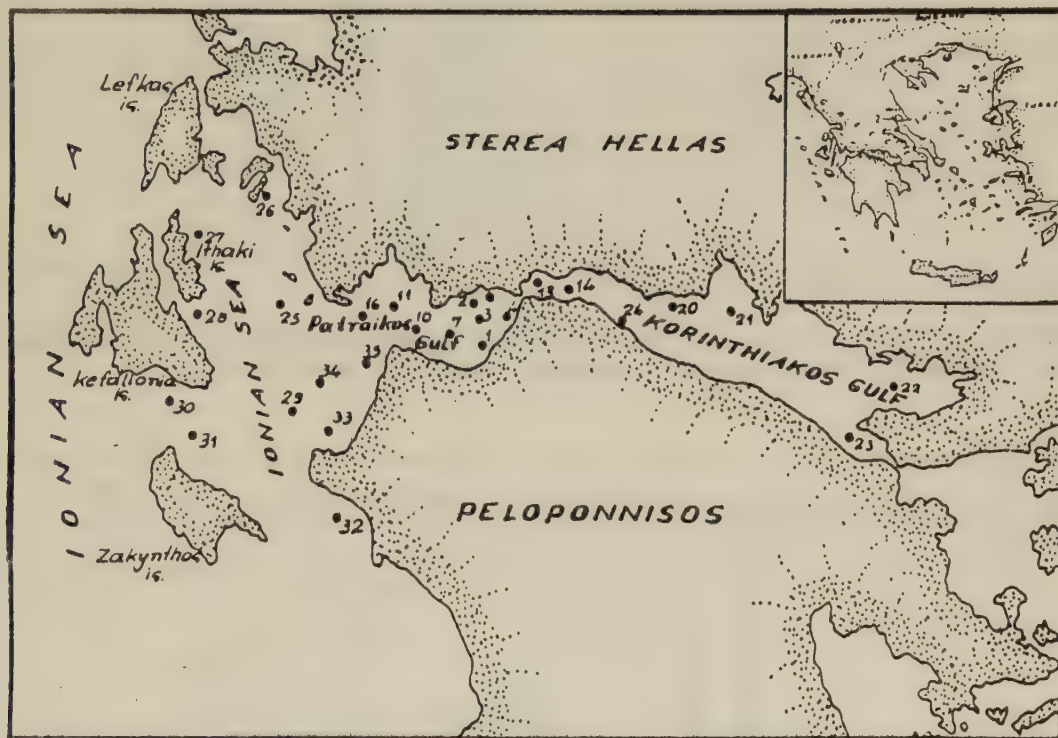


Figure 1 - Stations d'échantillonnage.

2. Relation Longueur|Poids

Le tableau 1 montre les paramètres de l'équation longueur|poids par zone d'échantillonnage (régression prédictive).

Tableau 1 - Paramètres de la relation longueur|poids par région ($W = a \times L^b$, où W en g et L en mm).

Région	a	b	r
Golfe de Patraikos	6×10^{-6}	3.120946	0.94
Golfe de Korinthiakos	4×10^{-6}	3.160834	0.92
Mer Ionienne	12×10^{-6}	3.000211	0.92

3. Croissance

L'âge des poissons est déterminé à l'aide de la lecture des otolithes; ces données sont utilisées pour le calcul des paramètres de croissance sur une base trimestrielle.

Le groupe d'âge 0 n'est pas exclu bien que son recrutement soit incomplet et qu'il ne soit pas entièrement présent dans la pêcherie, en raison de sa très forte abondance (aux environs de 60% de la pêche totale, pendant l'échantillonnage).

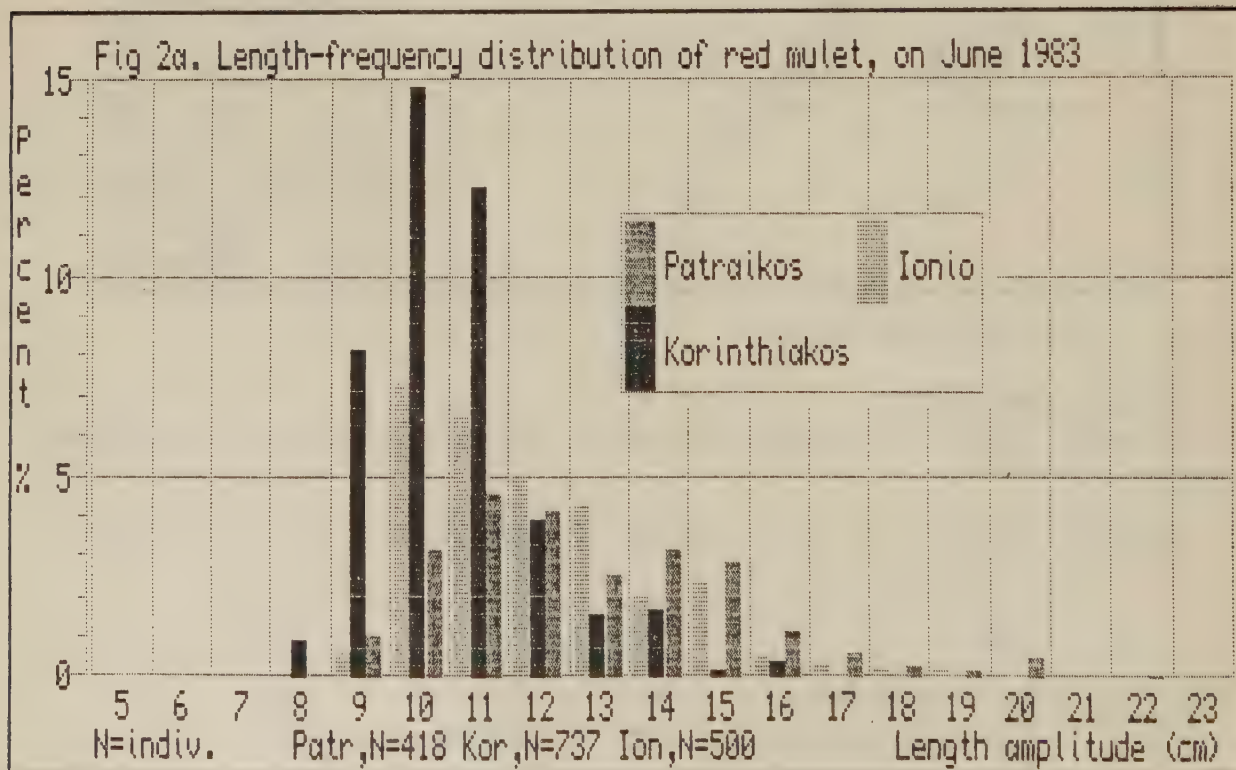
Le tableau 2 montre les paramètres de croissance de l'équation de von Bertalanffy.

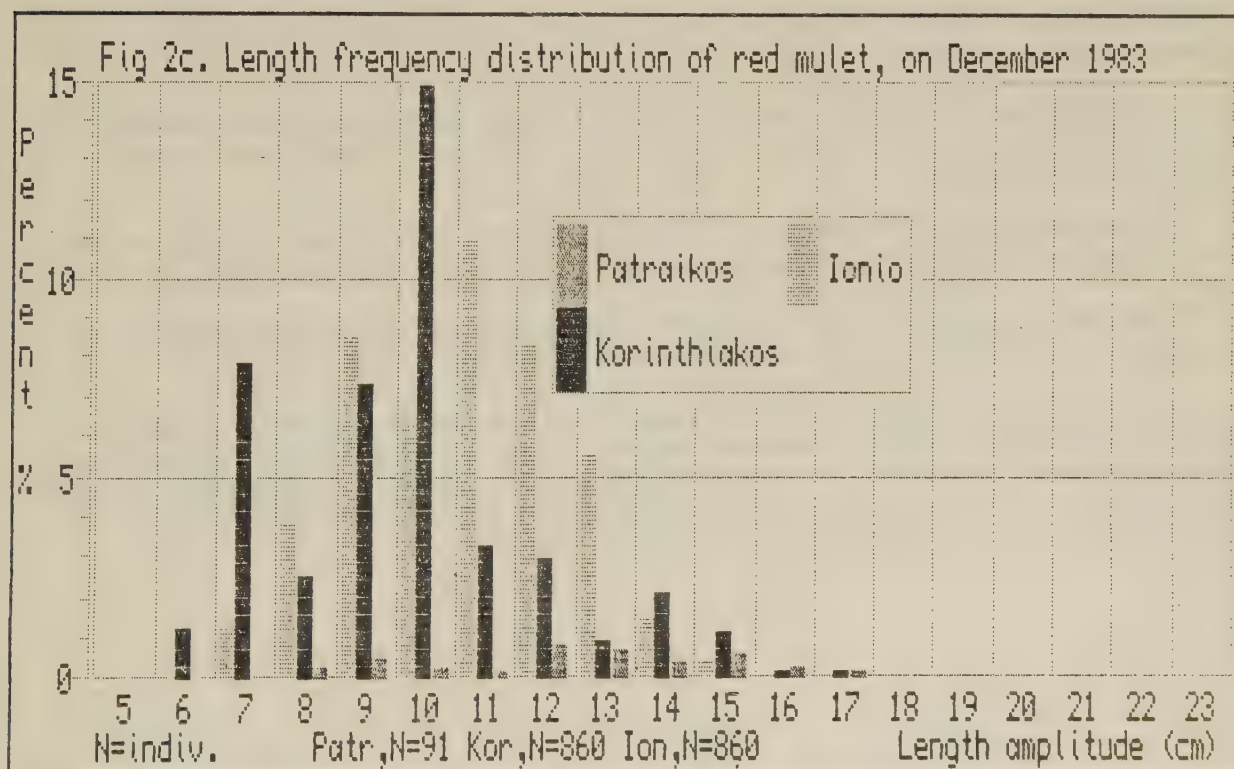
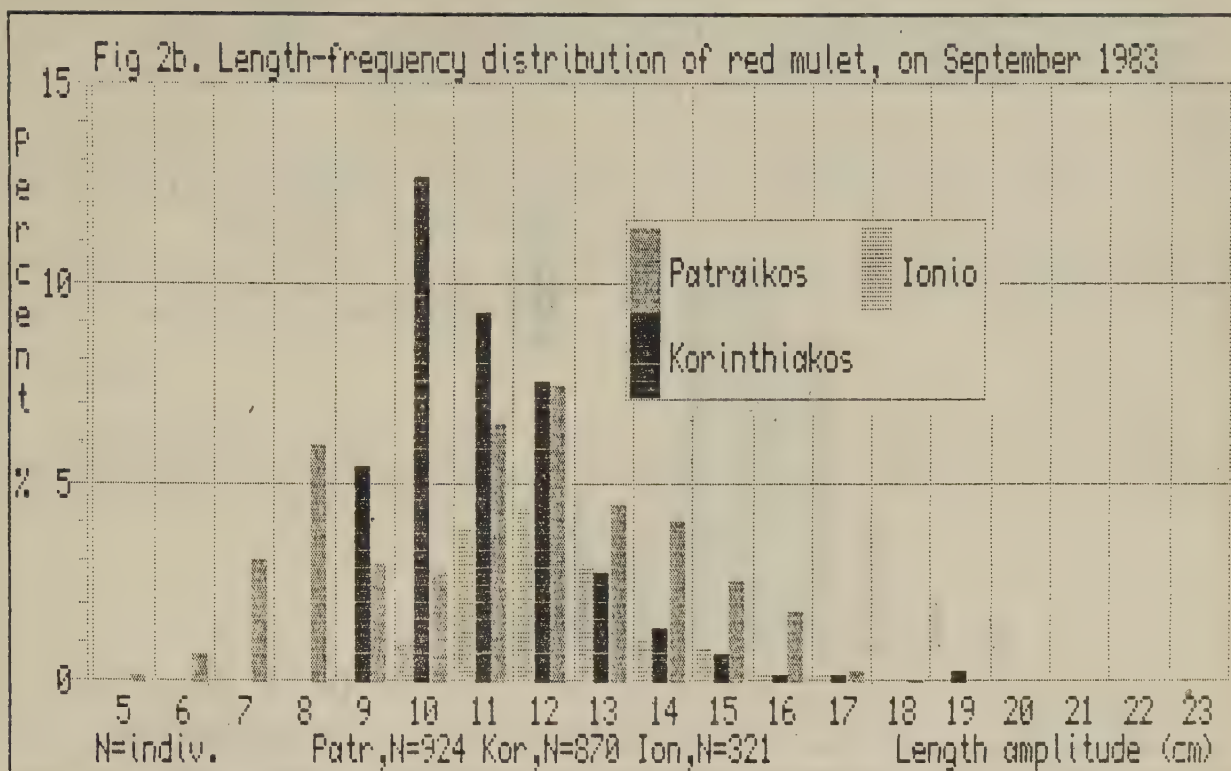
Tableau 2 - Paramètres de croissance de l'équation de von Bertalanffy.

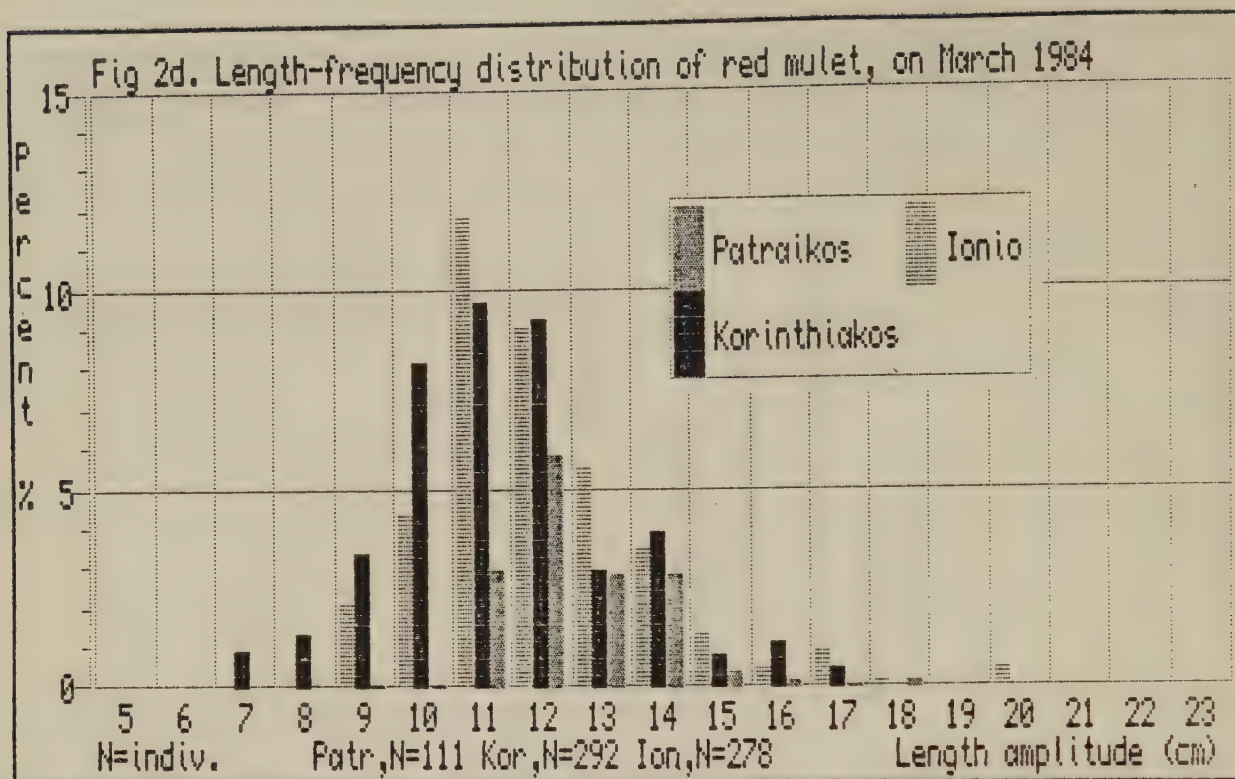
Région	L _∞ (mm)	K
Golfe de Patraikos	233.1	0.049
Golfe de korinthiakos	214.9	0.038
Mer Ionienne	228.5	0.043
Région totale	246.3	0.040

4. Distributions de fréquence des longueurs

Les figures (2a à 2d) montrent la distribution de fréquence des longueurs de M. barbatus par région échantillonnée, pendant les quatre saisons d'échantillonnage.







Il en résulte que :

- La distribution des fréquences des tailles du rouget dans le golfe de Korinthisakos et la mer Ionienne est presque la même.
- Les nouvelles recrues arrivent dans le golfe de Patraikos pendant les mois de printemps et jusqu'au mois de décembre; dans le golfe de Korinthisakos et la mer Ionienne elles arrivent pendant le mois de décembre.
- La population du golfe de Patraikos se compose en majorité d'individus de 150-110 mm (56%) alors que celle du golfe de Korinthisakos se compose d'individus de 110 à 90 mm (55%).
- Le fait que *M. barbatus* se reproduise après l'âge de deux ans, est un fort indice que les deux golfes sont des lieux de reproduction (Papaconstantinou, *et. al.*, 1981).
- Les jeunes individus (groupe 0) d'une longueur de 110 mm. semblent se déplacer du golfe de Patraikos vers la mer Ionienne; la géomorphologie du passage vers la mer Ionienne est convenable pour ce déplacement; par contre, un déplacement similaire vers le golfe de Korinthisakos ne semble pas avoir lieu, peut être à cause de la géomorphologie de ce dernier (communication limitée entre les deux golfes, grande profondeur du golfe de Korinthisakos).

f) La diminution brusque de l'importance du groupe 0 dans le golfe de Patraikos pendant le mois de décembre est due, d'une part au déplacement de cette fraction de la population vers la mer Ionienne (ce déplacement se termine au mois de décembre), et de l'autre, à la mortalité par pêche de la population en tenant compte du fait que la pêche au chalut commence vers le mois de décembre.

g) La fréquence de présence des individus plus âgés augmente en fonction de la profondeur, mais en majorité ces individus n'apparaissent pas au-delà de l'isobathe de 50 m dans le golfe de Patraikos. Dans la mer Ionienne, ils apparaissent jusqu'à l'isobathe de 100 m.

h) D'après cette analyse, on peut dire qu'il y a deux populations de rouget indépendantes; la première se trouve dans le golfe de Korinthiakos et la deuxième dans celui de Patraikos ainsi que dans la mer Ionienne jusqu'à l'isobathe de 100 m.

5. Mortalité

La mortalité totale a été calculée à l'aide de la méthode des courbes de capture en longueur converties de Pauly (1980), dans l'hypothèse qu'un recrutement constant existe et que la recherche s'effectue sur une base pluriannuelle.

TABLE 3. Data for the construction of a catch curve for the red mullet from the Patraikos-Korinthiakos Gulf and Ionian Sea (total area)

Class limits		mid-	N	2/		D_t	adjusted number per length class $\log_e(N/D_t)$	mean relative age	remarks
lower	Upper	range		t_1	t_2				
5.00	5.99	5.5	6	0.567	0.697	0.130	3.826	0.632	not used:
6.00	6.99	6.5	44	0.697	0.835	0.138	5.765	0.766	ascending
7.00	7.99	7.5	242	0.835	0.981	0.146	7.413	0.908	part of
8.00	8.99	8.5	281	0.981	1.136	0.155	7.502	1.059	the curve
9.00	9.99	9.5	687	1.136	1.302	0.166	8.332	1.219	
10.00	10.99	10.5	1273	1.302	1.479	0.177	8.880	1.390	
11.00	11.99	11.5	1240	1.479	1.669	0.190	8.780	1.574	
12.00	12.99	12.5	1022	1.669	1.875	0.206	8.508	1.772	
13.00	13.99	13.5	571	1.875	2.100	0.225	7.840	1.988	Portion
14.00	14.99	14.5	405	2.100	2.347	0.247	7.402	2.224	used for
15.00	15.99	15.5	254	2.347	2.621	0.274	6.831	2.484	estima-
16.00	16.99	16.5	117	2.621	2.929	0.308	5.940	2.775	ting z
17.00	17.99	17.5	59	2.929	3.280	0.351	5.123	3.105	
18.00	18.99	18.5	23	3.280	3.689	0.409	4.030	3.485	
19.00	19.99	19.5	21	3.689	4.178	0.489	3.760	3.934	
20.00	20.99	20.5	15	4.178	4.786	0.608	3.205	4.482	
21.00	21.99	21.5	0	4.786	5.592	0.806	-	5.189	
22.00	22.99	22.5	3	5.592	6.788	1.196	0.919	6.190	

1/ fork length in cm

2/ computed by means of the equation, $t-t_0 = \log_e(1-l_t/l_0)/(-k)$ with $t_0=0$.

Le tableau 4 montre les coefficients de mortalité (Z) pour chaque zone.

Tableau 4 - Coefficient de mortalité totale (Z), mortalité par pêche (F), mortalité naturelle (M) et taux d'exploitation (E) par région.

Région	Z	F	M	E
Golfe de Patraikos	0.709	0.509	0.20	0.72
Golfe de Korinthiakos	0.662	0.492	0.17	0.74
Mer Ionienne	0.694	0.514	0.18	0.74
Région totale	0.595	0.415	0.18	0.70

La mortalité naturelle (M) a été calculée selon la méthode de Pauly, basée sur l'estimation de L_∞, K et T (température moyenne de l'environnement) ($M = 0.179$).

Le taux d'exploitation (E) qui a été calculé selon la formule : $E = F / (F + M)$, est important ($E = 0.73$). Ceci indique une surpêche du stock du rouget dans la région étudiée car on admet généralement que le stock est pleinement exploité quand $F \approx M$ et $E \approx 0.50$.

6. References

Papaconstantinou, C.N. Tsimenidis, Ch. Daoulas, 1981. Age growth and reproduction of red mullet (Mullus barbatus L., 1758 in the Gulfs of Saronikos and Thermaikos. Thalassographica vol. 4, no. 1; 39-66.

Pauly, D., 1981. A selection of simple methods for the assessment of tropical fish stocks. FAO Fish. Circ. (729); 54p.

ANNEX (E) L

Distribution and abundance of *Chlamys opercularis* (L.) and
Pecten jacobaeus L. in the Adriatic Sea

by

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A. Šimunović and S. Jukić, Institute of Oceanography and Fisheries, Split

1. Introduction

Under the framework of the bilateral research programme on monitoring and assessment of Adriatic multispecies demersal resources, the "PIPETA" trawl survey programme was conducted by the Laboratorio di Biologia Marina e Pesca in Fano and the Institute of Oceanography and Fisheries in Split during 1982-84. The main objectives of the programme were the monitoring of abundance and the assessment of the major commercial stocks (fish, cephalopods, crustaceans) available to the trawl fishery for the promotion and implementation of a proper management plan and for better understanding of the relationships among benthic communities over the Adriatic continental shelf in connection to abiotic (hydrographic, sediments, sea depth) and biotic characteristics in the surveyed areas.

Taking into consideration the potential importance of certain species of the family Pectinidae, studies on distribution and abundance indices of two species, the queen scallop (*Chlamys opercularis*) and the pilgrim's scallop (*Pecten jacobaeus*) were undertaken and the results are reported in this paper.

When studying the benthic communities in the Adriatic, a significant number of authors have dealt with the distribution of *C. opercularis* and *P. jacobaeus* in connection to the sea sediments and sea depth. VATOVA (1928, 1949) found distribution of both species in the northern Adriatic on sandy sediments and at the same time noted their commercial importance for markets in Venice, Trieste and the west coast of Istria. Distribution characteristics, mostly in connection with sandy bottom sediments are described in papers by COEN and VATOVA (1933); O. KARLOVAC (1959); GAMULIN-BRIDA (1962); STJEPCEVIC (1967); ZAVODNIK (1971); PERES & GAMULIN-BRIDA (1973); COLANTONI (1974); PARENZAN (1974); ALVIZI *et al* (1978); COLANTONI *et al* (1980); STJEPCEVIC & PARENZAN (1980); GRUBISIC (1982) and RIEDL (1983).

2. Material and Methods

Trawl surveys in 1982-84 were conducted over 9 transects with a total number of 58 to 60 fixed and pre-planned stations from the north Adriatic down to Monte Gargano covering a great part of circalittoral zone of the Adriatic continental shelf. Sampling patterns, gear characteristics and timing were carefully considered and maintained as constant as was possible during each cruise. Seasonal and diurnal aspects of benthic communities were studied as well.

For the trawl surveys, the standard Italian bottom trawl was used (PICCINETTI, 1972) on the commercial vessel "PIPETA" (300 hp; 70 GRT) to obtain an abundance index (catch per unit effort-cpue) for *C. opercularis* and *P. jacobaeus* in the surveyed area.

On the stations with sandy bottom sediments, 8 wooden rollers ("rugoli") were attached to the trawl's ground-rope, while in the case of stations with silty-clay sediments the wooden rollers were taken away. Bottom trawl was towed at a speed of 3.5 knots per hour and because of the scarceness of a certain number of commercially important species, two drags were made on each station.

For species with low abundance, like P. jacobaeus the whole catch was sorted out and weight for every individual was measured.

Relative index of abundance for both species on each station with a non-zero catch was calculated as a mean value of the two trawl tows and standardized as catch (in weight) per hour. These abundance indexes were used in the calculation of standing stock(s) size for C. opercularis and P. jacobaeus in the area of its maximum abundance distributions, i.e. in the northern Adriatic (Fig. 1).

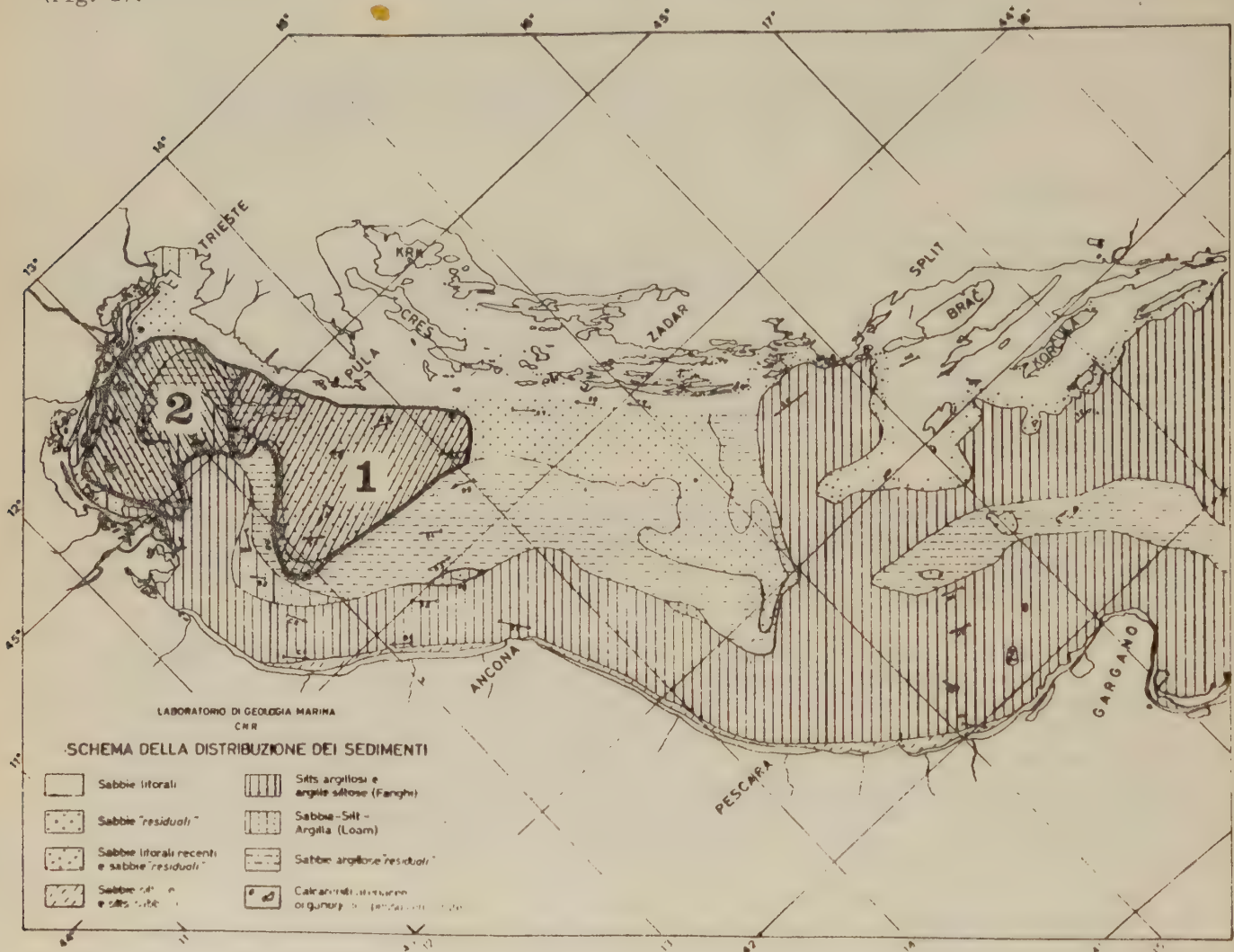


Figure 1 - Distribution of Clamys opercularis - Sub-areas 1 and 2 refer to table 3.

For this purpose the widely known "swept area" technique (ALVERSON and PEREYRA, 1969; PAULY, 1982) was used, assuming that the catch per unit of effort is proportional to stock density and that under certain rough assumptions regarding the catchability coefficient of the species, the standing stock size (B) is given by the relationship:

$$B = \frac{\overline{c/f} \cdot A}{a \cdot q_1} \quad (1)$$

where B = total biomass of the population in the surveyed area; $\overline{c/f}$ = average catch per unit effort (c.p.u.e.), or weight (kg) of the species per one towing hour; A = total surface of the surveyed area inhabited by the species; this area in the case of C. opercularis in the northern Adriatic is 8.988 km², while for P. jacobaeus it is 11.394 km²; a = "swept area" by trawl in unit time (for "PIPETTA" a = 0.077784 km²; q₁ = "coefficient of vulnerability" of the species (taken = 1.0).

3. Results and Discussion

Data on distribution and abundance of C. opercularis collected during 1982-84 are presented in Tables 1, 2 and 3.

Table 1 - Relationship between sea depth and abundance of C. opercularis for the stations where species has been found.

Sea depth range (m)	20-29	30-39	40-49	50-62
A1-	0.79	A4- 0.00	B4- 1087.80	C7- 161.71
A1-	1.04	A4- 0.47	B6- 30.09	D5- 23.13
A1-	0.41	A7- 152.46	B6- 10.30	D5- 15.30
A2-	2.40	A7- 9.41	B7- 45.38	D6- 134.07
A2-	9.60	A7- 7.66	B7- 7.31	D6- 366.15
A2-	10.67	A8- 11.90	B9- 477.15	D6- 26.48
A3-	1.85	A8- 21.50	C3- 228.62	D7- 4.65
A3-	71.34	B1- 21.06	C3- 900.95	D7- 2.80
A3-	10.93	B3- 50.70	C4- 27.04	
A4-	11.46	B3- 34.12	C4- 73.14	
A6-	1.82	B3- 10.04	C5- 659.53	
A6-	27.00	B4- 451.00	C5- 1432.19	
A9-	10.40	B9- 170.93	C5- 212.05	
A9-	7.13	C4- 39.27	C6- 725.09	
B1-	1.60		C6- 1563.49	
			C6- 547.60	
			C7- 35.25	
Average (kg)	:11.23	:70.04	:474.29	:91.79

Table 2 - Relationship between sea depth and average length (cm) measured over the maximal small axis of Chlamys opercularis

Sea depth range (m)	20-29	30-39	40-49	50-62
A1-	4.0	A4- 3.0	B4- 6.6	C7- 5.5
A1-	3.8	A7- 2.9	B6- 5.7	D5- 3.5
A1-	3.4	A7- 2.8	B6- 6.6	D5- 3.8
A2-	4.4	A7- 4.2	B7- 4.5	D6- 4.0
A2-	3.2	A8- 4.0	B7- 6.8	D6- 4.5
A2-	3.7	A8- 6.5	B9- 3.8	D6- 5.6
A3-	4.2	B1- 4.0	C3- 4.5	D7- 2.0
A3-	3.8	B3- 2.5	C3- 6.6	D7- 2.0
A3-	3.7	B3- 6.7	C4- 5.3	
A4-	4.0	B3- 4.0	C4- 6.5	
A6-	2.8	B4- 4.0	C5- 5.6	
A6-	3.7	B9- 2.8	C5- 5.8	
A9-	3.7	C4- 2.8	C5- 5.8	
A9-	3.7		C6- 4.4	
B1-	4.0		C6- 5.7	
			C6- 5.6	
			C7- 2.8	
Average length (cm)	:3.7	3.9	5.4	3.9

Table 3 - Average weights(kg) per stations during 1982-1984 for Chlamys opercularis within two surveyed sub-areas (1) and (2) in the northern Adriatic.

Surveyed area	(1)	(2)
	B4- 769.40	A1- 0.75
	B6- 20.20	A2- 7.56
	B7- 26.35	A3- 28.04
	B9- 324.04	A4- 3.98
	C3- 564.79	A6- 14.41
	C4- 46.48	A7- 56.51
	C5- 767.92	A8- 16.70
	C6- 945.39	A9- 8.77
	C7- 98.48	B1- 11.33
	D5- 19.21	B3- 31.62
	D6- 175.57	
	D7- 3.76	
Average (kg)	: 313.47	: 17.97

It has been found that this species is mostly distributed in shallow waters and in the northern part of the Adriatic, mostly between sandy and sandy-loamy sediments (Fig. 1). It does not live deeper than 62 - 66 meters. The highest abundance values are found from 40 to 49 meters (Table 1) with an average mean value of 474.3 kg per hour, while the lowest was registered between 20 and 29 metres with an abundance index of 11.2 kg. per hour.

Average shell length (measured over the longest axe) had its highest value on the stations between 40-49 metres (5.4 cm) while the smallest were found between 20 - 29 metres (3.7 cm) (Table 2). The overall abundance index for the three cruises of 1982, 1983 and 1984 (table 3) of C. opercularis has been taken for assessment of standing stock size of this species within two sub-areas in the northern Adriatic (see Figs. 1 and 2).

The sub-area (1) has an average abundance value of 313.47 kg per hour and sub-area (2) of 17.97 kg per hour. From these values an index of the total biomass of queen scallop area has been estimated: Area (1) B = 21.122 tons and area (2) B = 865 tons. Gross total for the whole surveyed area in northern Adriatic B = 21.987 tons.

With regard to distribution and abundance of P. jacobaeus it is found that this species has a wider distribution than the queen scallop in the northern Adriatic, with significantly smaller values of abundance index. However, like the queen scallop, it is mostly distributed on sandy and sandy-loamy bottom sediments, not deeper than 69 to 72 meters (Fig. 2).

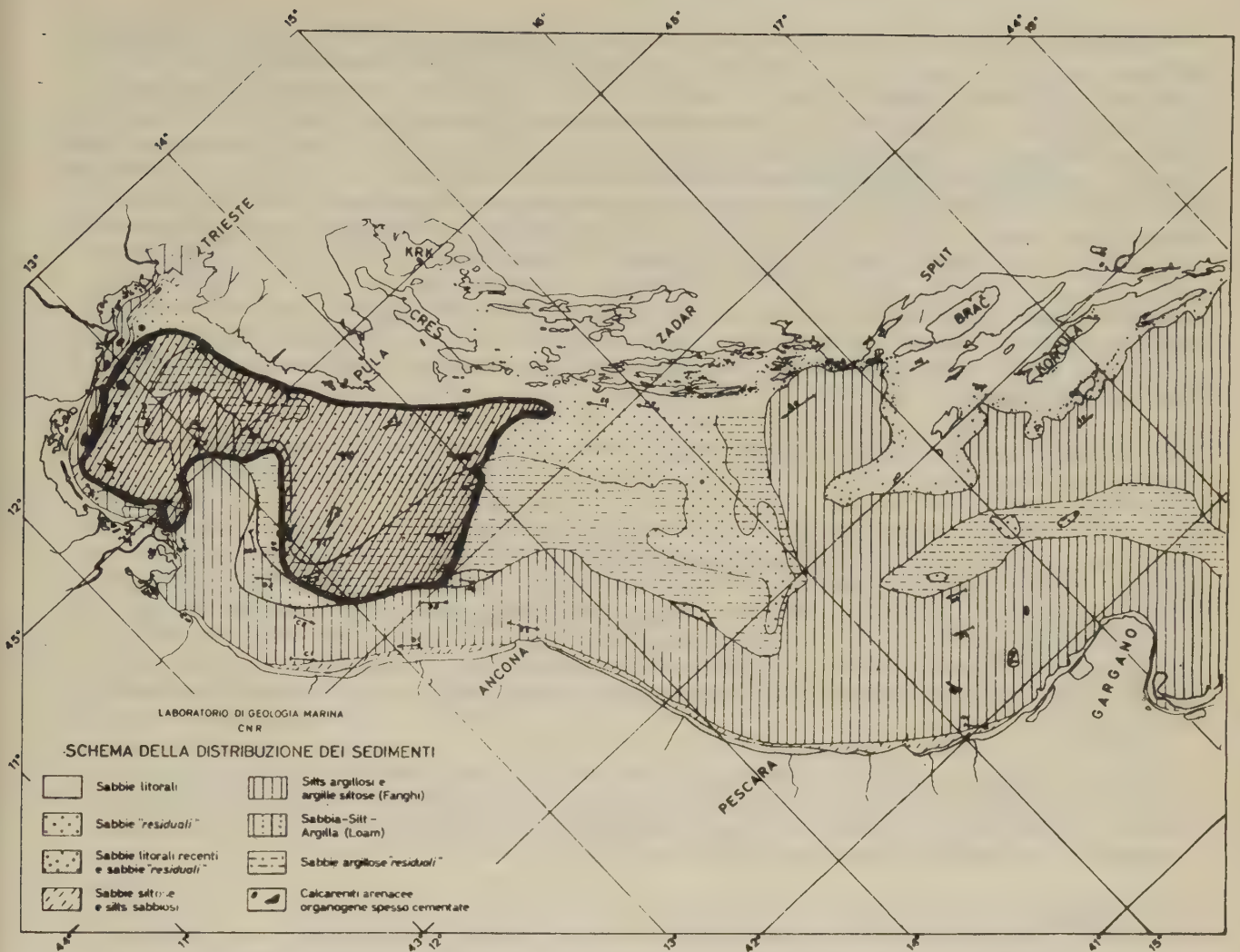


Figure 2 - Distribution of Pecten jacobaeus (circled area)

The index of abundance reaches its maximum value between 40 - 49 metres (1.22 kg per hour) while its lowest abundance is observed between 50 - 59 metres (0.28 kg per hour), Table 4.

Table 4 - Relationship between sea depth and abundance of Pecten jacobaeus L. for the surveyed stations.

Sea depth range	20-29	30-39	40-49	50-59	60-69
A2- 0.00	A7- 1.44	B4- 0.23	C7- 0.25	D3- 0.25	
A2- 0.20	A7- 0.56	B7- 0.05	D3- 0.28	D3- 0.30	
A2- 0.07	A7- 0.11	B7- 0.13	D5- 0.15	D4- 0.22	
A3- 0.16	A8- 0.00	B9- 0.06	D6- 0.57	D4- 0.15	
A3- 0.00	A8- 0.14	C3- 0.59	D6- 0.27	D4- 0.18	
A3- 0.43	B1- 2.58	C3- 0.88	D7- 0.18	D5- 0.50	
A6- 4.20	B3- 0.00	C4- 0.05	D7- 0.25	D5- 0.73	
A6- 0.75	B3- 0.00	C4- 1.08		D6- 1.00	
A9- 0.36	B3- 0.13	C5- 1.86		E7- 0.35	
A9- 0.90	B4- 0.00	C5- 2.80			
B1- 0.22	B9- 0.10	C5- 2.09			
	C4- 0.90	C6- 5.15			
		C6- 1.85			
		C6- 1.35			
		C7- 0.20			
Average (kg)	: 0.65	:0.50	:1.22	0.28	:0.40

The above results on distribution and abundance of C. opercularis and P. jacobaeus in the Adriatic, especially for species distribution in relation to bottom sediments and depth, are very much similar to previous authors' findings, who stated that both species have a preference for sandy bottom sediments and do not live below 50 metres. VIVIANI et al. (1974) investigating the distribution of C. opercularis and P. jacobaeus in the Adriatic found their distribution among Tellina, Turritella and Nucula communities, mostly on sandy sediments. According to COLANTONI and GALLIGNANI (1978, 1980) these two species are found in the northern and open Adriatic, mostly among sandy sediments. RIEDL (1983) for C. opercularis has stated that this species lives on all types of bottom sediments, while P. jacobaeus dwells on soft bottoms. STJEPCEVIC (1967) found this species in the most southern part of the Adriatic (Boka Kotorska) on sandy sediments in accordance with other findings for the central Adriatic (GAMULIN-BRIDA, 1962; GRUBIŠIĆ, 1982). However, along the eastern Adriatic coast, these species do not live deeper than 50 metres. PERES and GAMULIN-BRIDA (1973) consider that both species are characteristic species of coastal detritic bottoms in the Mediterranean.

It must be said that the studies by these authors in the Adriatic were mostly connected to species ecological aspects as a part of a general benthic biocoenoses dynamics studies.

VATOVA (1949) reported some catch data of Chlamys and Pecten for the northern Adriatic, for the markets of Venice, Trieste and Istra and stated that in 1929 on these markets yields of Chlamys and Pecten was 14.9 tons. PARENZAN (1974) stated that in the coastal region, close to Chioggia at depths between 18-22 metres, P. jacobaeus commercial daily catch was 200-300 kg. According to PAGOTTO (1985) at the fish market of Chioggia in 1984 more than 1000 tons of Pecten were sold. By comparison with our index of biomass for this species, it is clear that the coefficient of catchability of this species for "PIPETA" net is much lower than 1 and that the biomass must be much higher.

Since C. opercularis and P. jacobaeus might potentially have commercial importance as a "food source" for trawl fishery and possible mariculture development in the northern Adriatic, present investigations of these two species have been mostly oriented toward quantitative stock assessment, in addition to ecological and distribution studies.

4. Conclusions

The distribution and abundance of C. opercularis and P. jacobaeus in the Adriatic Sea, as observed in 1982-84 are as follows:

- the distribution is connected with the nature of bottom sediments and sea-depth, i.e. both species mostly prevail on sandy and partly sandy-loamy bottom sediments and do not live deeper than 62 to 66 metres, in the case of C. opercularis, and 69-72 metres for P. jacobaeus. In deeper waters and on silty-clay sediments no specimens of these two species were found.
- the size of the standing stock of C. opercularis and P. jacobaeus in the northern and shallower part of the Adriatic indicates that these species and above all the queen scallop might represent an additional source of sea food.

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ANNEX (E) M

Abundance of non-commercial fish in the Patraikos and Korinthiakos Gulfs
and the Ionian Sea, Greece

by

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ABSTRACT

The CPUE of 13 non-commercial fish species was estimated from samples collected during seasonal cruises between June 1983 and April 1985 in the Patraikos and Korinthiakos Gulfs and the Ionian Sea. The temporal changes of the species composition and abundance in the catches, and the repercussions of the opening of the trawl fishing season on the catches is discussed in the text.

1. Introduction

In order to evaluate the fish stock potential of a given marine region, actual catches must be expressed per unit of fishing effort, otherwise conclusions and/or estimations may be biased and/or erratic. Furthermore, qualitative and quantitative data on the variation of the catches with time (seasonal and long-term) are required for a holistic approach to the problem. However, in the absence of such data, information on stock structure collected by a research vessel (in this case it is a commercial vessel used for research) is also very useful.

In the present work, carried out in the framework of the fisheries investigations in Hellenic waters, information pertaining to the temporal (within year and between years) and spatial variability of the CPUE (catch per unit of fishing effort) of 13 non-commercial fish species in the Patraikos and Korinthiakos Gulfs and the Ionian Sea (Figure 1) is presented. These species accounted for 70% of the total catch in these regions.

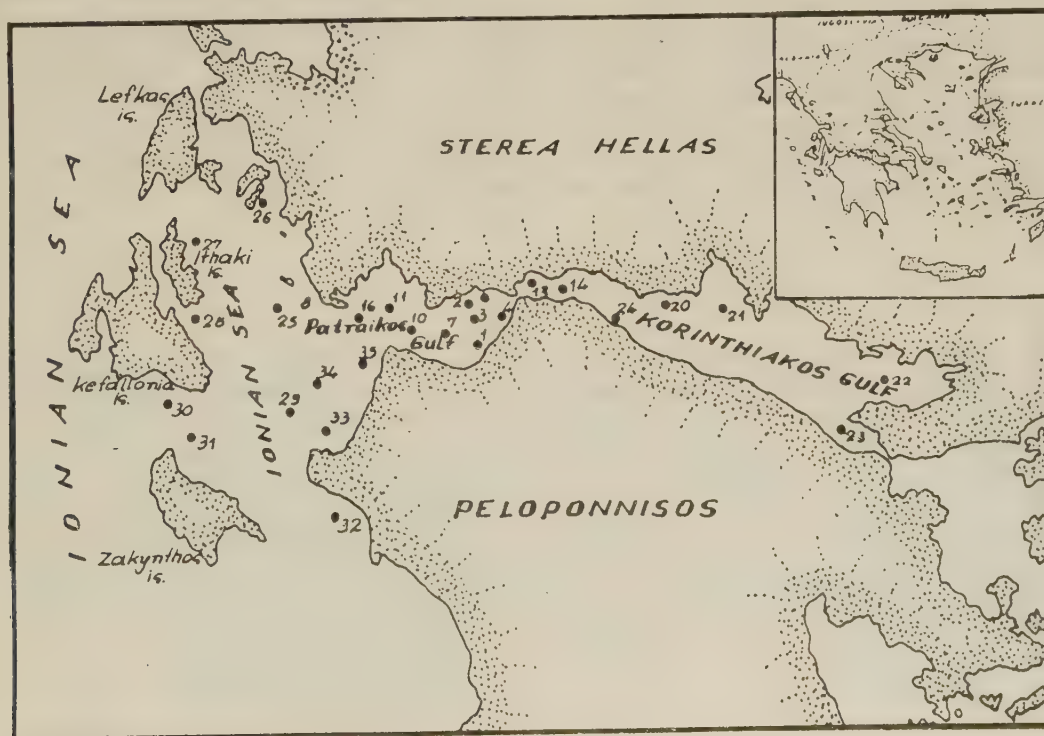


Figure 1 - Locations of sampling stations.

2. Materials and Methods

The sampling stations (systematic sampling) were selected on the basis of the nature of the substrate, the depth and the fishing activity in the area.

Trawl samples were collected by means of a 425 HP motorboat equipped with a 14 mm mesh-size net (from knot-to-knot) at the cod-end, during seasonal cruises from June 1983 to April 1985. Each haul lasted 45 minutes.

The length, sex and maturity stage according to Nikolsky's (1976) scale were determined on board. Consequently, the length-weight relationship and the length-frequency distribution of 13 fish species were used in order to estimate the CPUE per species.

3. Results and Discussion

Tables 1 and 2 show that the species composition and abundance varied greatly with respect to time (within year and between years) during the studied period.

In general, any sampling period was dominated by a group of 2-4 species, while all other fishes represented a small percentage of the catch. It is obvious, however, that Trisopterus minutus capelanus dominated the Patraikos Gulf catches during the whole June 1983-April 1985 period (with the exception of September 1984 and April 1985), its abundance averaging 7.20 kg./h (37.6% of the 2-year annual average of the Patraikos Gulf catch).

Gadiculus argenteus argenteus, on the other hand, accounted for the major portion of the Korinthiakos Gulf catches, with an average CPUE of 59.50 kg/h (58.9% of the 2-year annual average of the Korinthiakos gulf catch). It also comprised an important part of the Ionian Sea catches, during the studied period, with the exception of December 1983 and March 1984, when no G. argenteus was caught. Investigations in the Gulf of Patras did not reveal any G. argenteus, mainly due to the restricted depth of the Gulf.

With regard to the annual cycle of the CPUE in the Gulf of Patras, Argentina sphyraena exhibited maxima and minima in September and June, respectively, during both years of investigation. The same holds for Trachurus trachurus in the Korinthiakos Gulf (maximum in December, minimum in June), T. minutus in the Patraikos Gulf (maximum in September, minimum in June). The CPUE of all other species fluctuated significantly with time without displaying any clear-cut pattern of variation. The only exceptions were: Diplodus annularis in the Gulf of Patras (maximum in September), Lepidotrigla cavillone in the Korinthiakos Gulf (maximum in December), Chlorophthalmus agassizi in the Ionian Sea (maximum in Spring), G. argenteus in the Korinthiakos Gulf (minimum in spring), and T. minutus in the Korinthiakos Gulf (maximum in December), that showed some sort of regularity.

Table 1.

Seasonal CPUE of 13 non-commercial fish species in the Patraikos (P) and Korinthiakos (K) Gulfs and the Ionian Sea (I) during June 1983-March 1984 (.... = CPUE < 0.01 or 0; ---- = data not available).

	JUNE 1983			SEPTEMBER 1983			DECEMBER 1983			MARCH 1984		
	P	K	I	P	K	I	P	K	I	P	K	I
<u>Trachurus trachurus</u>	0.63	0.19	0.93	2.99	1.87	1.65	4.27	8.75	0.75	0.73	2.50	0.30
<u>Argentina sphyraena</u>	0.10	2.01	2.50	0.58	1.55	2.50	0.24	4.10		0.12	1.87	2.74
<u>Capros aper</u>		1.78	57.14		0.48			0.66			1.47	1.09
<u>Chlorophthalmus agassizi</u>			0.17			0.91						2.15
<u>Gadiculus argenteus argenteus</u>		63.69	10.26		98.36	3.22		150.45			29.24	
<u>Coelorhynchus coelorhynchus</u>		3.01	0.24		11.90			3.00			0.55	
<u>Lepidotrigla deuseidei</u>			5.50			5.17						1.31
<u>Lepidotrigla cavillone</u>	0.12	0.60	0.45	0.96	1.30	1.00	1.48	4.75	1.08	0.78	0.56	0.73
<u>Irisopterus minutus capellanus</u>	18.18		0.32	7.86	0.59	1.82	8.17	5.22	2.07	2.85	2.23	1.07
<u>Diplodus annularis</u>	2.64		0.44	7.76	0.99	0.37				0.52	0.07	0.35
<u>Pagellus acarne</u>	16.90	7.60	1.78	2.37	71.80	0.30	0.03	32.83	4.30	0.04	8.25	0.60
<u>Serranus hepatus</u>	0.11	2.78	0.29	0.74	2.67	0.32	0.22	3.90	0.60	0.16	1.59	0.57
<u>Spicara smaris</u>	----	----	----	2.97	17.84	10.34	0.05	0.20	0.50	0.03	0.30	4.70
Total=	38.68	81.66	80.02	26.23	209.35	27.60	14.46	213.86	9.30	5.23	48.63	15.61

Table 2.

Seasonal CPUE of 13 non-commercial fish species in the Patraikos (P) and Korinthiakos (K) Gulfs and the Ionian Sea (I) during June 1984-April 1985 (.... = CPUE < 0.01 or 0).

	JUNE 1984			SEPTEMBER 1984			DECEMBER 1984			APRIL 1985		
	P	K	I	P	K	I	P	K	I	P	K	I
<u>Trachurus trachurus</u>	1.43	0.45	0.37	1.14	1.40	1.10	4.65	32.31	1.09	10.87	4.52	2.00
<u>Argentina sphyraena</u>	0.12	5.31	1.46	2.58	3.61	1.60	0.29	2.97	2.69	0.57	2.79	2.69
<u>Capros aper</u>	0.01	1.04	4.71	0.01	0.18	0.02	0.10	0.13	39.16		15.41	
<u>Chlorophthalmus agassizi</u>			1.25			0.32			0.39			2.07
<u>Gadiculus argenteus argenteus</u>	0.64	47.05	40.84	3.54	23.51	83.42	1.41	43.81	23.57		19.60	75.62
<u>Coelorhynchus coelorhynchus</u>		0.24			0.22			1.53			2.70	0.16
<u>Lepidotrigla deuseidei</u>			2.12			3.39			18.89			5.27
<u>Lepidotrigla cavillone</u>	0.98	3.49	1.13	0.84	1.41	2.23	0.99	4.60	0.35	0.78	2.43	1.51
<u>Irisopterus minutus capellanus</u>	6.53	0.33	1.01	6.19	0.43	1.40	0.10	0.08	0.52	1.37	1.57	0.90
<u>Diplodus annularis</u>	3.77	1.38	0.75	4.32	0.10	0.25	0.10	0.85	0.38	3.39	1.48	5.34
<u>Pagellus acarne</u>	0.52	1.99	5.55	0.28	0.96	17.06	0.55	0.85	1.62	1.62	13.13	2.39
<u>Serranus hepatus</u>	0.33	3.11	1.07	0.48	1.74	1.64	0.31	2.15	0.95	0.42	2.80	0.89
<u>Spicara smaris</u>	0.25	0.49	4.60	0.16		0.70	0.05		1.57	0.43	0.29	2.80
Total=	14.58	64.88	64.86	19.54	33.56	113.13	14.86	90.03	90.98	19.45	66.72	101.64

Figure 2 represents the seasonal variation of the CPUE of commercial species (hake, red pandora and red mullet) together with the variation of the total catch rate for the three regions. Data are restricted to the June 1983-March 1984 period. One realises that the relative proportion of non-commercial species is high in the Korinthiakos Gulf as opposed to the Petraikos Gulf and Ionian Sea, supporting the idea of a limited fishing interest of the Korinthiakos Gulf. Furthermore, the seasonal variation of the total CPUE in the Petraikos Gulf and Ionian Sea is closely related to the opening of the trawl fishing season. Namely, catch rates decrease along with the opening of the season in November and increase slowly again with the end of the season after June. This was not the case for the Korinthiakos Gulf, mainly due to the low level of effort exerted.

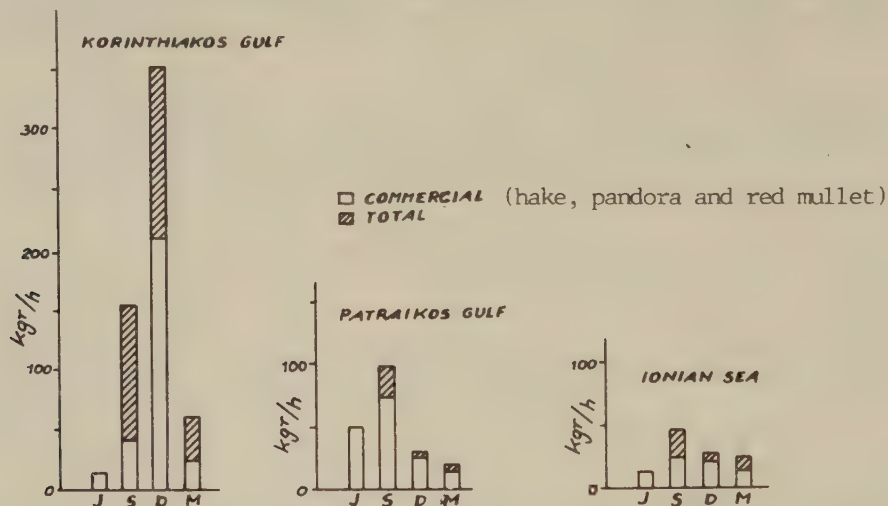


Figure 2 - Seasonal variations of the CPUE of commercially important species together with the seasonal variations of the total catch in the Petraikos and Korinthiakos Gulfs and the Ionian Sea for June 1983 - March 1984.

The great variation of the species composition and abundance in the catches has important biological and economic repercussions. Although oscillations, in general, are bad for any system (Dunbar, 1960), they maintain at a high level the species diversity of the ecosystem by lowering the intensity of predation and interspecific competition, thus adding stability (Hurd *et al.*, 1971) to the system. Moreover, since the commercial efficiency of a multispecies fishery, such as the trawl fishery, is a function of value and biomass, it will be greatly affected, among other things, by the species composition and relative abundance of commercial and non-commercial species.

4. Conclusions

- The species composition and abundance in the catches varied greatly with time.
- T. minutus* dominated the Petraikos Gulf catches and *G. argenteus* the Korinthiakos Gulf catches.
- Korinthiakos Gulf, as opposed to Petraikos Gulf and Ionian Sea, seems to be of limited fishing interest.
- The opening of the trawl fishing season in November leads to decreased CPUE in the Petraikos Gulf and the Ionian Sea during winter and spring. CPUE increases slowly again in summer and autumn when the fishing season ends. This was not observed in the Korinthiakos Gulf, mainly due to its limited fishing interest.

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ANNEX (E) N

Diurnal changes in fishery resources catchability by
bottom trawl in the Adriatic Sea

by

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INTRODUCTION

Any assessment of stock abundance by means of trawl surveys is influenced by gear efficiency and fish behaviour.

As a rule gears (net and ship) are constant through a survey; fish behaviour, which influences catchability, undergoes changes with a more or less circadian periodicity, and trawl catch composition shows important diurnal changes.

Knowledge of diurnal changes in species catchability is fundamental for a proper planning and interpretation of trawl surveys data in order to increase accuracy and precision of relative abundance estimates.

Diurnal patterns of catchability were extensively investigated outside the Mediterranean (Gulland, 1964; Sissenwine and Bowman, 1978; Bowman and Bowman, 1980). In the Mediterranean area these aspects received little attention (Jukic, 1972; Froglija and Gramitto, 1982).

With reference to catchability by a bottom trawl Froglija (1982) recognized four groups of species (Figure 1):

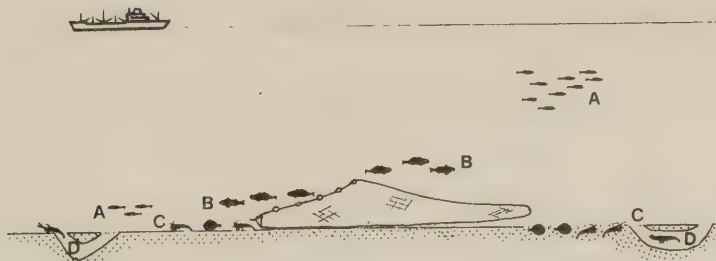


FIG. 1 - Vulnerability of different species groups (see text) by a bottom trawl (from Froglija, 1982)

- A) **Pelagic species** - frequently in schools, caught only when their distance from the ground is less than the vertical opening of the net (vertical opening of a Mediterranean bottom trawl is around 1 m (Fiorentini and Cosimi, 1981)).
- B) **Demersal species** - at least at daytime are very close to the bottom.
- C) **Benthic species** - more or less able to hide themselves into the sediments.
- D) **Benthic burrowing species** - dig tunnels under the ground.

Individual of the last two categories are caught when active outside the burrow and on the ground. Highest catches are obtained with nets able to dig sediments.

Information on catchability of several species, gathered during our investigations on Adriatic trawling grounds, are herein summarized together with data on habitat and feeding behaviour, in the attempt to call attention to a phenomenon that needs further detailed investigations.

SOURCES OF DATA

Data recorded during our experimental trawlings with the R/V S. Lo Bianco in the Adriatic sea were used.

Only hauls made with the same net, at the same stations, mostly within a 24 hours period, were considered. Hauls that extended to two hours before and after dawn or dusk were omitted from the analysis. The catch ratios by number and by weight was computed for each pair (day-night) of hauls thus obtained.

Diel catchability ratio is expressed by the formula

$$\frac{C_d - C_n}{C_d + C_n} \cdot 100$$

where C_d is the day catch and C_n is the night catch; it assumes the value +100 in species caught only at day and the value -100 in species caught only at night; 0 if there is no difference between day and night catches.

The t of Student distribution is used to test significance of difference of the mean value of catchability ratio from zero.

Results obtained on circalitoral (depth 20-100 m) and epibathial (depth 200-250 m) grounds are considered separately in Tables 1-2.

To show influence of alimentary rhythms on species catchability some results of stomach content investigations carried out for a long time in our Institution to investigate prey preferences and species interrelationships are herein included.

TAB. 1 - Dial catchability ratios of some Adriatic fishes caught by bottom trawl

Species	Catchability mean (min-max)	depth m	N. hauls pairs	Specimens caught (N)
M. merluccius (LT<21cm)	+48** (+ 6; + 94)	<100	29	2382
M. merluccius (LT<21cm)	+88** (+ 69; + 99)	200-250	13	7166
M. merluccius (LT≥21cm)	+31** (- 56; + 74)	<100	26	1032
M. merluccius (LT≥21cm)	+23* (- 33; + 48)	200-250	13	245
T. minutus capelanus	+ 8 (- 72; + 82)	<100	34	16316
T. minutus capelanus	+34** (- 16; + 71)	200-250	13	5654
M. merlangus	+37** (- 33; + 91)	<100	20	1168
M. poutassou	+ 5 (- 78; + 97)	200-250	13	2057
G. argenteus	+25* (- 63; + 74)	200-250	13	12093
A. megalokynodon	-58** (- 91; + 26)	<100	24	1938
A. megalokynodon	- 7 (-100; + 93)	200-250	12	321
S. hepatus	+50** (+ 2; + 80)	<100	8	1472
C. macrophthalma	+70** (- 47; + 97)	<100	29	3906
G. niger	+43 (- 83; + 65)	<100	28	1780
L. friesii	-33** (- 91; + 38)	<100	24	4812
L. friesii	- 9 (- 55; + 47)	200-250	12	4300
B. boops	+56** (-100; +100)	<100	23	619
P. erythrinus	-54** (- 64; - 46)	<100	4	1231
S. flexuosa	+11 (-100; +100)	<100	32	735
M. barbatus	+55** (- 60; + 90)	<100	17	2552
L. cavillone	-42* (- 67; - 10)	<100	4	3243
T. draco	-67** (-100; +100)	<100	10	101
Trachurus spp.	+85** (+ 34; +100)	<100	21	3486
Trachurus spp.	+43** (- 38; + 85)	200-250	12	1649
S. vulgaris	-64** (-100; +100)	<100	24	203
S. variegata	-95** (-100; - 78)	<100	7	219
S. lutea	-48** (-100; + 4)	<100	13	460
A. laterna	-14** (- 55; + 41)	<100	34	5401

TAB. 2 - Diel catchability ratios of some Adriatic invertebrates caught by bottom trawl

Species	Catchability mean (min-max)	depth m	N. hauls pairs	N. specimens caught
N. norvegicus	-42** (-100;+ 35)	<100	28	1941
N. norvegicus	+63** (+ 16;+ 82)	200-250	13	4122
S. mantis	-61** (-100;+ 33)	<100	20	4611
S. officinalis	-10 (-100;+ 49)	<100	16	878
L. vulgaris	+61** (-100;+100)	<100	19	307
Ommastrephidae	+91** (+ 53;+100)	200-250	8	1462

* Significantly different from 0.

** Very significantly different from 0.

In these studies samples collected at selected times (noon - dusk - midnight - dawn) and stomach fullness is estimated by a four points subjective scale.

RESULTS AND DISCUSSION

Species habits (demersal - benthic - pelagic - burrowing) and preys habits (pelagic, benthic, etc.) as derived from our observations and from literature are summarized in Table 3 together with our results on diurnal changes in catchability.

Catchability of most demersal species (group B) shows a clear decrease by night time.

This change is particularly evident in juveniles (LT< 21 cm) of Hake, both on the continental shelf and on its edge. The shelf edge (depth 200-250 m) is a nursery ground for young Hakes feeding on micronecton (Euphausiids - Lophogaster typicus and Maurolicus muelleri) (Frogia, 1982; Zupanovic, 1968).

Micronecton stays close to the bottom by day time and moves to upper layers by night time (Jukic, 1978); young Hakes probably follow their preys in this vertical movement. In fact the highest vacuity coefficient was recorded in trawl samples obtained with bottom trawl at night (Figure 2A).

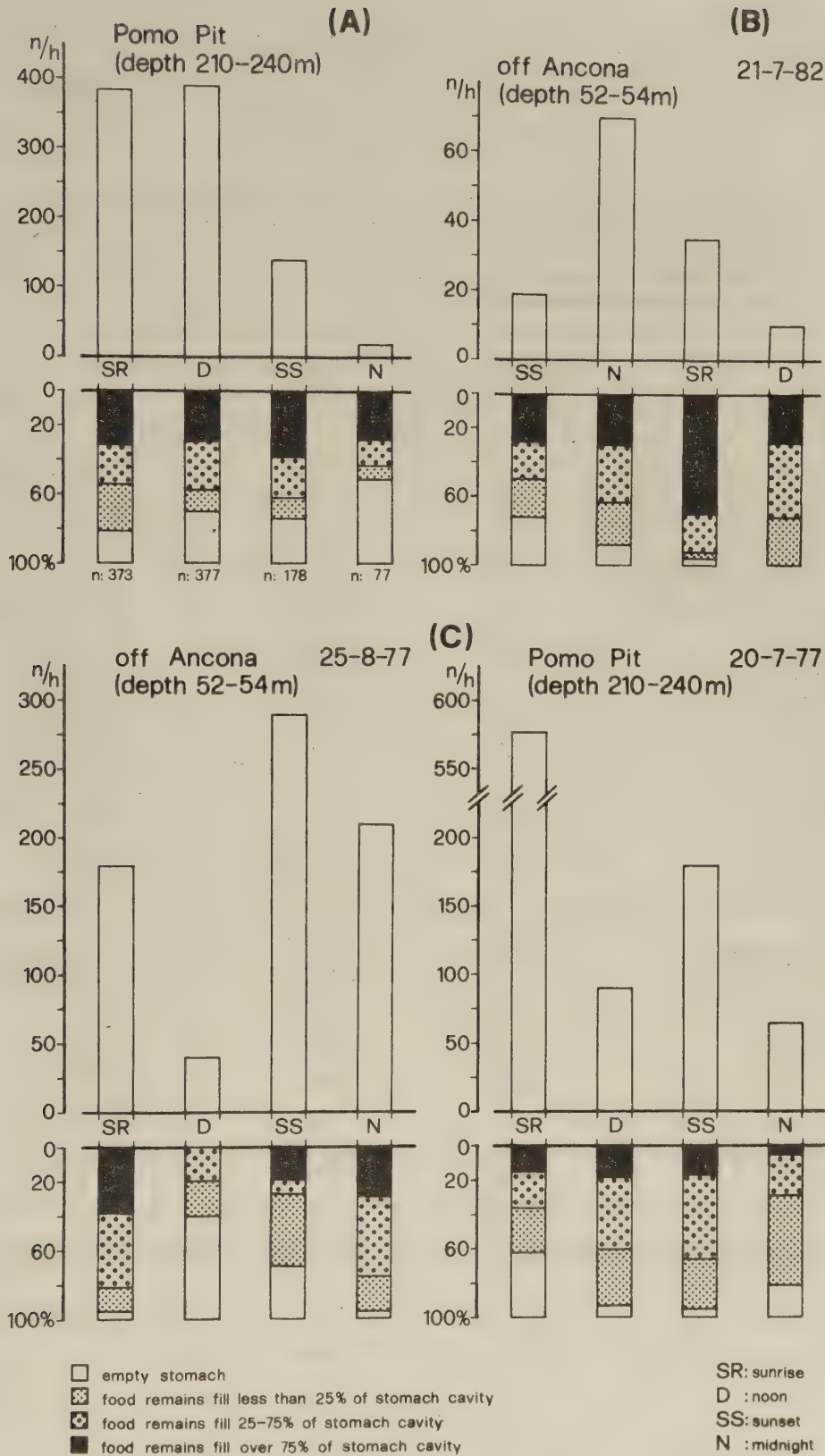


Fig. 2 - Relationship between dial catchability (number/hour trawling) and feeding activity (stomachs fullness).

A: juvenile hakes (*M. merluccius*) in an average diurnal cycle in the Western Pomo Pit;

B: *A. megalokynodon* in a diurnal cycle on a muddy bottom off Ancona;

C: *N. norvegicus* in a diurnal cycle on shallow waters (off Ancona) and on deep waters (Pomo Pit)

TAB. 3 - Time of higher catchability, habit and habit of main preys for some species commonly caught on Adriatic trawling grounds
(Sources of data for predators and preys habit are listed in the References section)

Species	catchability (Day/Night)	depth m	habit ^o	main preys habit
M. merluccius (LT<21cm)	D	<100	B	Pelagic+Benthic
M. merluccius (LT<21cm)	D	200-250	B	Epipelagic
M. merluccius (LT≥21cm)	D	<100	B	Pelagic+Benthic
M. merluccius (LT≥21cm)	D	200-250	B	Pelagic+Benthic
T. minutus capelanus	-	<100	B	Benthic
T. minutus capelanus	D	200-250	B	Benthic+Epipelagic
M. merlangus	D	<100	B	Benthic+Epipelagic
G. argenteus	D	200-250	B	Epipelagic
A. megalokynodon	N	<100	C	Benthic
A. megalokynodon	-	200-250	C	Benthic
S. hepatus	D	<100	B	Benthic
C. macrophthalma	D	<100	D	Zooplankton
L. friesii	N	<100	D	Benthic
L. friesii	-	200-250	D	Benthic
B. boops	D	<100	A	Zooplankton
P. erythrinus	N	<100	B	Benthic
M. barbatus	D	<100	B	Benthic
L. cavillone	N	<100	B	Benthic
T. draco	N	<100	C	Benthic
Trachurus spp.	D	<100	A	Pelagic
Trachurus spp.	D	200-250	A	Epipelagic
S. vulgaris	N	<100	C	Benthic
S. variegata	N	<100	C	Benthic
S. lutea	N	<100	C	Benthic
A. laterna	N	<100	C	Benthic
N. norvegicus	N	<100	D	Benthic
N. norvegicus	D	200-250	D	Benthic
S. mantis	N	<100	D	Benthic

^o A = pelagic; B = demersal; C = benthic; D = benthic burrowing

The same catchability ratio is observed for pelagic species (group A) like Squids and Horse Makarels that at day time are close to the bottom and at night usually scatter in the water mass up to the surface.

Benthic species of the group C are more vulnerable at night time; for Antonogadus megalokynodon we could prove a correlation with feeding rhythm (Figure 2B) (Gramitto, in press).

De Groot (1971) evidenced two feeding strategies in Pleuronectiformes: visual search (day feeders) and olfactory search (night feeders). All the Soleidae are olfactory searchers and in our investigation actually show a higher vulnerability by night.

Emergence out of burrow for species of group D is sometime under influence of light intensity, and can result in the reversal of the catchability ratio in shallow or deep waters.

This phenomenon is well documented for the Norway Lobster (Chapman, 1980; Frogliia and Gramitto, 1981).

Feeding activity of this species, as derived from our stomach contents analysis, is well correlated with its catchability and then to its activity out of burrows (Figure 2C).

CONCLUSIONS

At present it seems unrealistic to estimate correction coefficients to extrapolate night catch from day catch and vice-versa but we hope this small contribution to the study of species catchability will prompt further investigations and will help in planning trawl surveys on the basis of known distribution of main target species.

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ANNEX (E) O

Note on biomass indices of *Chamelea gallina*
(Mollusca, bivalvia) beds along the western Adriatic coast

by

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1. Introduction

Coastal areas of the western Adriatic are mostly shallow and sandy. From Monfalcone to Barletta these bottoms, up to 12 meters deep, are characterized by a "Venus community".

On these grounds *Chamelea gallina* is abundant enough to support a specialized fishery with hydraulic clam dredges. The use of hydraulic dredges started in the late sixties and at present over 600 "vongolare" boats are harvesting this resource with an estimated annual production of about 100,000 metric tons.

Clams are marketed fresh in Italy and Spain or processed.

In 1969 to prevent overexploitation, the minimum size of marketable clams was fixed at 25 mm; in 1979 and in 1980 other provisions of the fishing authority fixed the size and characteristics of fishing devices and fishing boats as well as the maximum daily catch per boat (2.5 metric tons) and the closed season (June).

In 1979, for the first time in Italy, a licence system was experimented for the fishery. Nevertheless, in several districts the present situation of the resources has not yet been optimized. For this reason in 1984 a three year programme supported by a grant from the Ministry of Merchant Marine (Research funds, law 41/82) was initiated. Several Adriatic institutions are committed to this programme covering the areas between Monfalcone and Caorle and between Goro and Barletta.

2. Methods

The first experimental cruises were carried out in June 1984, a period in which fishing is forbidden.

The survey was conducted by commercial hydraulic clam dredges or similar equipment.

A systematic sampling strategy was chosen. The sampling stations (tows of standard length = 50 meters) were placed along transects perpendicular to the coast and spaced two miles from the -2 m. bathymetric line at 1 meter intervals until depths where clams were practically absent. Due to particular local situations it was necessary to make some changes in the original plan. The whole catch was sampled and, except for some cases, no subsamples were made. All clams have been weighed and their length has been measured to the lower millimeter. Out of all data collected in the present work, only the biomass indices of the commercial fraction are supplied for each district in the area concerned. No surveys were performed in the Districts of Venice and Chioggia.

3. Results

These preliminary results have to be considered cautiously; they are merely indicative and cannot be used for management purposes. It is necessary to improve the methods, to integrate these data with other sets available to complete this research and achieve a thorough insight on the stock status and on possible levels of exploitation.

It must be pointed out that for the first time in Italy, thanks to this grant, collaboration was set up between several Adriatic institutions on this problem. This is reported to have positive results as to the management of this resource within the districts studied.

The biomass indices of Chamelea gallina (commercial fraction: ≥ 25 mm) are the following:

<u>District</u>	<u>Metric tons</u>	<u>density (kg. per 1,000 m²)</u>
Monfalcone	744	16.9
Ravenna	220	1.9
Rimini	3300	17.4
Ancona	4849	20.8
S. Benedetto	7961	52.5
Pescara	11137	26.6
Manfredonia	2205	12.4
Molfetta	402	35.1

ANNEX (E) P

Remarks on rings formation in otoliths of *Solea vulgaris* and other flatfishes from the Adriatic Sea

by

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Count of opaque and hyaline rings formed on fish otoliths, as a result of different environmental and physiological conditions of a fish through its life is a well-known, worldwide used technique to determine the age of fish (Jensen, 1965).

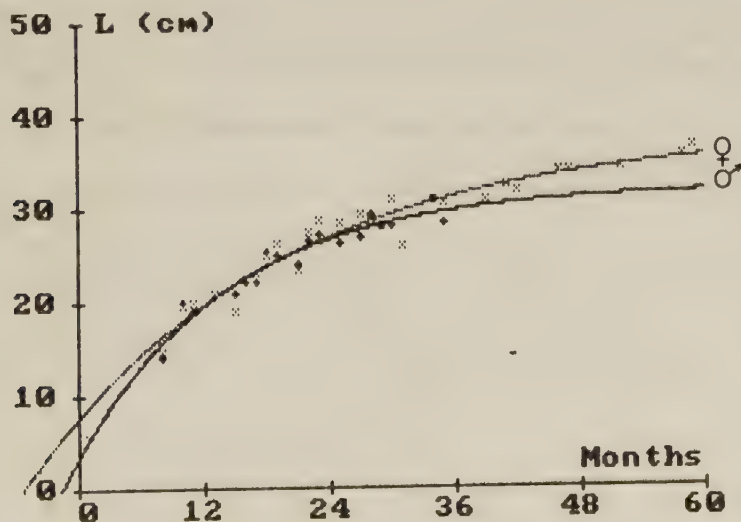
Growth estimates, in the form of von Bertalanffy's growth equation, were obtained with this method for the common Sole, (*Solea vulgaris*) in the Atlantic (Daniel, 1984), the North Sea (de Veen, 1976) and the Mediterranean (Mendez de Elgueabal, 1978 in Shehata, 1984).

We used the same method in our investigation on growth of *S. vulgaris* in the Adriatic, and a preliminary report was presented to the XXIX ICSEM Congress (Froglija and Giannetti, in press); further investigations made it possible to compute separately growth equations for the two sexes, and results are summarized in Tab. 1 and Figure 1.

Table 1 - Parameters of the von Bertalanffy growth equation for *Solea vulgaris* in the Adriatic Sea

	N. otoliths	W _∞ (g)	L _∞ (cm)	K	t ₀ (months)
Males	143	323	23.20	0.069	-1.66
Females	193	562	37.87	0.042	-5.36
Both sexes	753	576	38.25	0.041	-3.57

Figure 1 - Von Bertalanffy growth curves for *S. vulgaris* in the Adriatic Sea.



Otoliths were examined under reflected light and the reader can refer to the above-mentioned paper by Froglija and Giannetti for technical details; here we shall deal only with the pattern of ring formation.

In cold and temperate waters the growth pattern of the otolith is as follows: deposition of a wide opaque ring with a higher content of calcium carbonate in the warm season, usually a period of intense growth, and deposition of a narrow hyaline ring with a lower content of calcium carbonate and a higher content of organic matter in the cold season, a period of reduced or zero growth (Holden and Raitt, 1974). Thus, one opaque plus one hyaline ring are interpreted as one year of life.

Physiological or environmental stress may produce false rings, making interpretation sometimes difficult. In warm temperate and particularly in tropical areas, where fish undergo continuous growth, otoliths frequently do not show any ring pattern.

Opaque and hyaline rings are well evident in nearly all the otoliths of sole examined, but their pattern is the opposite to the above mentioned rules, i.e. we found that a wide hyaline ring is formed in summer months (first appearance in May) and an opaque ring (already detectable in November) is formed in the winter months. It is worth mentioning that Franzoi and Rossi (in press) for northern Adriatic plaice (Platichthys flesus luscus) already evidenced a shift of some months in the appearance of the hyaline and opaque rings.

We had the possibility to examine a very small number of brill (Scophthalmus rhombus) and turbot (Psetta maxima) from the Adriatic Sea and once again the formation of the hyaline band seems to start in late spring.

Sole, plaice, brill and turbot are Pleuronectiformes with a boreal distribution that does not extend south of Morocco. In the Mediterranean Sea they are more frequent in the northern, cooler part of the basin and all are known to spawn in winter. It may be that, in the Adriatic, all these Pleuronectiformes have a common pattern in otoliths formation related not to seasonal growth but to biological and physiological cycles.

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ANNEX (E) Q

Catching results of small pelagic fish in mid-water trawling
in the period 1979 - 1984

by

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1. Introduction

Nowadays pelagic fishing makes 81-83% of the total Yugoslav fish catch in the Adriatic. Basic fish catching method is purse seining with use of artificial light. However, over the past few years the possibility of introducing a midwater trawl has been discussed. In this respect, research was carried out in 1970 and fully confirmed the possibility of catching small pelagic fish by midwater trawl and a new fishing industry began in 1979.

The purpose of this work is to present the results of the catch of small pelagic fish in midwater trawling, and also to compare them with the purse seine fishing results. A considerable amount of material for this work has been collected from fish-processing factories in Yugoslavia, "Riba" Izola, "Skoljka" Porec and "Mima" Rovinj and the material used in the literature was also used.

2. Fishing Fleet Situation of the Public Sector (SFRJ)

Today the Yugoslav fishing fleet (public sector only) accounts for 135 fishing vessels, the majority having been built before 1960. Fleet modernization started in 1978 and is continuing. The fleet structure of the public sector is given in table 1.

Table 1 - Fishing Fleet Structure (SFRJ) in 1984

	Total	Purse Seine	Midwater Trawl	Bottom Trawl
Nb	135	91	18	26
GRT	7992	4880	1966	1146
%	100	67.4	13.3	19.2

The majority (67.4%) is purse seiners with the following characteristics:

- a) Power of the main engine rarely exceeds 220 KW. (usually 110 - 147 KW).
- b) Small area on working deck.
- c) Fish holds are located in the middle of the boat; their fish-carrying capacity ranges from 1 to 10 tons of fish, which limits the possibility of bigger catches.
- d) The majority of boats are made from wood; many of them are completely deteriorated, requiring their general repair or their withdrawal from exploitation.

Purse seine fishing is performed at night and without the moon. Taking into consideration that purse seine fishing in the Adriatic has a seasonal character and considering all the factors mentioned above, it is easy to come to the conclusion that catch by purse seine is limited.

Since 1979 Yugoslav effort towards the development of midwater trawling has intensified, to increase the number of fishing days, eliminate peak fishing seasons, avoid rough weather conditions and improve catch efficiency.

Development of new fishing technology required the building of new modern fishing vessels (see Table 1).

Table 2 shows the characteristics of midwater trawlers.

Table 2 - Technical Characteristics of Midwater Trawlers:

Characteristic	Vessel Type			
	Intermaris	Greben	Droga	Mirna
L(m)	23.19	23.19	29.13	27.00
B(m)	6.86	6.86	6.60	6.20
H(m)	3.70	3.70	3.20	-
Engine Output (KW)	240	488	488	316
Hold Capacity	110	85	100	60

"Intermaris" and "Greben" vessels are multipurpose fishing vessels, intended for trawling and purse seining, while "Droga" and "Mirna" vessels are classical stern trawlers intended for fishing with trawler's gear.

The advantages of the midwater trawler are:

- Relatively low dependence on weather conditions;
- More fishing days;
- Fishing at night and day;
- Smaller crew
- Equal distribution of catches to fish processing factories.

3. Results of midwater trawlers and their comparison with purse seine

Since 1979 the percentages of fish caught by midwater trawling has rapidly increased, whereas purse seine fishing is decreasing (see Table 3).

Table 3 - Percentages of catch by fishing gear used for fishing in SFRJ (Public Sector only)

Year	Total (T)	Fishing Gear				
		Purse seine	Midwater trawler	Bottom trawler	Tuna seiner	Other fishing gear
1979	25.792	21531	2651	909	659	43
	100%	86.4%	10.3%	3.5%	2.5%	8.1%
1980	26.762	22206	3061	526	878	91
	100%	82.9%	11.4%	1.9%	3.4%	6.4%
1981	34.734	28831.	4477	702	364	360
	100%	83.1%	12.9%	2.02%	1.05%	1.04%
1982	31.297	23406	6166	829	388	508
	100%	74.8%	19.7%	2.65%	1.24%	1.62%
1983	39.672	27233	10050	869	1214	506
	100%	68.3%	25.2%	2.17%	3.04%	1.26%
1984	35.242	24010	8380	728	807	1317
	100%	68.1%	23.7%	2.06%	2.3%	3.7%

A new fishing technique is applied with midwater trawling with two boats operating in pairs. Permanent catch increases with midwater trawlers of "Riba" Izola, "Mirna" Rovinj and "Školjka" Poreč are shown in table 4.

Table 4 - Yearly Catch with Midwater Trawlers (in tons)

Fish Factory	Boat	Exploitation Year				
		1979	1980	1981	1982	1983
"Riba" Izola	Intermaris I & II	677	200	1065	888	1002
	Droga I & II	-	-	1443	1326	1570
	Delamaris I & II	-	-	-	738	1400
	Neptun I & II	-	-	-	340	977
Total		677	200	2508	3292	4949
Fleet		4017	4017	6010	5743	8184
Midwater trawler		16.8%	27.4%	41.7%	57.8%	61.0%
"Mirna" Rovinj	Mirna I & II	1022	1282	992	894	1682
Total		1022	1282	992	894	1682
Fleet		6319	6380	7551	633	8046
Midwater trawler		16.2%	20.1%	13.1%	14.1%	20.9%
"Školjka" Poreč	Školjka I & II	-	-	252	1070	1536
Total		-	-	252	1069	1536
Fleet		-	-	2263	2897	3248
Midwater trawler		-	-	11.1%	36.9%	47.3%

To make the analysis more complete, fish catching results are taken from some of the best purse seiners for 1983 at fish factories "Riba" and "Školjka". That was a record year for the last ten years in Yugoslavia. Fish catching with purse seiners are described in tables 5 and 6.

Table 5 - Purse Seines Catches of "Riba" - Izola, 1983 (tons)

Boat's Name						
Klen	Krap	Knežak	Sulec	Val	Zlatoperka	Mečanica
243	253	232	337	165	199	219

Table 6 - Purse Seines Catches of "Školjka" Porec, 1983 (tons)

Boat's Name				
Svjetlica	Bukva	Srebrnjak	Kapica	Srčanka
220	207	344	207	296

Tables 5 and 6 compared with table 4 show that midwater trawlers reach far better catching results than purse seiners.

Midwater trawlers are also making a better average daily catch, which is shown in table 7.

Table 7 - Purse Seines and Midwater Trawlers Average Daily Catch of "Školjka" Poreč
in 1983 (tons/day)

Boat	Catch (tons)	Number of Fishing Days	Average Daily Catch (tons)
<u>Trawlers</u>			
Školjka I	728	192	3.9
Školjka II	768	192	3.9
<u>Purse Seiners</u>			
Svjeticica	220	80	2.7
Bukva	207	96	2.2
Srebrnjak	345	121	2.8
Kapica	207	87	2.4
Srčanka	296	103	2.8

However, it must be emphasized that in Yugoslavia the purse seine fishery cannot be fully eliminated.

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ANNEX (E) R

Catch per unit effort as an index of sardine (*Sardina pilchardus* Walb.) distribution changes along the eastern Adriatic

by

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1. INTRODUCTION

Abundance indices based on catch and effort data have been used for the estimation of the size of exploited sardine (*Sardina pilchardus* Walb.) population, fishing intensity, fishing mortality, exploitation level and other parameters (Alegría, 1983, 1984),

However, behavioural characteristics of this species in relation to biotic and abiotic properties of the environment considerably affect the variations of fishing effort expended in different fishing areas and, accordingly, the values of catch per unit effort necessary for the analysis of population size fluctuations.

If we accept the assumption that several sardine subpopulations inhabit the Adriatic, of which at least two are exploited along the eastern Adriatic coast, the distribution of each of these subpopulations should be known to be able to calculate corresponding index of abundance for respective areas. In this paper we are trying to contribute to the population estimates analysing the seasonal changes in space-time pattern of catch per unit effort on the basis of the variations of their frequency distributions in the northern and middle Adriatic.

2. MATERIAL AND METHODS

Five data series on daily sardine catch per purse-seiner, collected during three years (1979, 1980 and 1981) were used. The data refer to five fishing areas of small pelagic fish in the eastern Adriatic (Fig. 1). The data of fishing vessels subject to the measure of restriction of fishing were not used. This measure was in force mainly during the autumn of 1981.

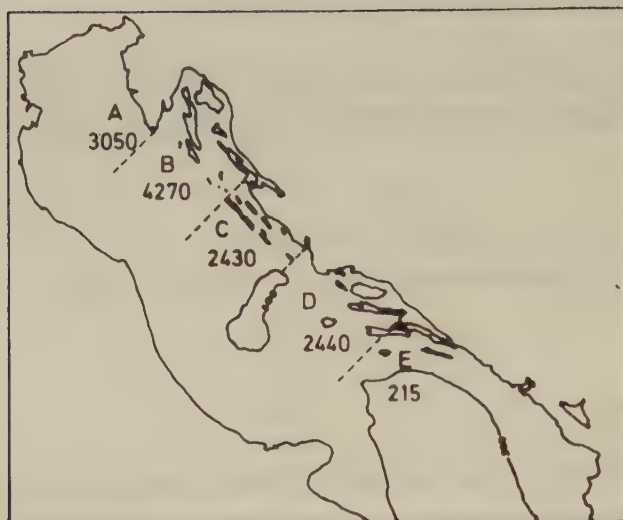


Fig. 1. Fishing areas and mean catch (tons) by areas in the Adriatic Sea, 1979-1981.

Nine categories of catch per fishing day (U) frequency were formed from the data series. Results were analysed by years and seasons, separately for each fishing area. From the total number of U values grouped by months, mean value ($\bar{U} = \sum U/n$, where n is the number of sets) and variance were calculated. From the relation mean/variance the value used as an index of fish schooling, i.e. aggregation, is obtained.

3. RESULTS

The data used represent about 70% of the total effort and the total purse-seine commercial catches of sardine in the eastern Adriatic between 1979 and 1981. Nine categories of catch per fishing days are given in Table 1. Annual frequency distributions of catch per fishing day in percentages are presented in Fig. 2, separately for each area. Results show that frequencies are not normally distributed but markedly skewed to the right. Distribution becomes less skewed to the right from year to year, particularly that referring to the areas C and D. Certain southwards cline in relation to the reduction of percentage of smaller catches and increase of frequency of larger catches per fishing day is also obvious. Even though this cline was not much evident in 1979, it was higher in 1980 and became very consistent in 1981.

Category	Catch range (kg)	Category	Catch range (kg)
<1	0 - 1000	12	9000 - 11000
2	1001 - 3000	13	11001 - 13000
4	3001 - 5000	14	13001 - 15000
6	5001 - 7000	>15	>15000
8	7001 - 9000		

Table 1. Categories of frequency distributions of catch per fishing day for sardine from the eastern Adriatic

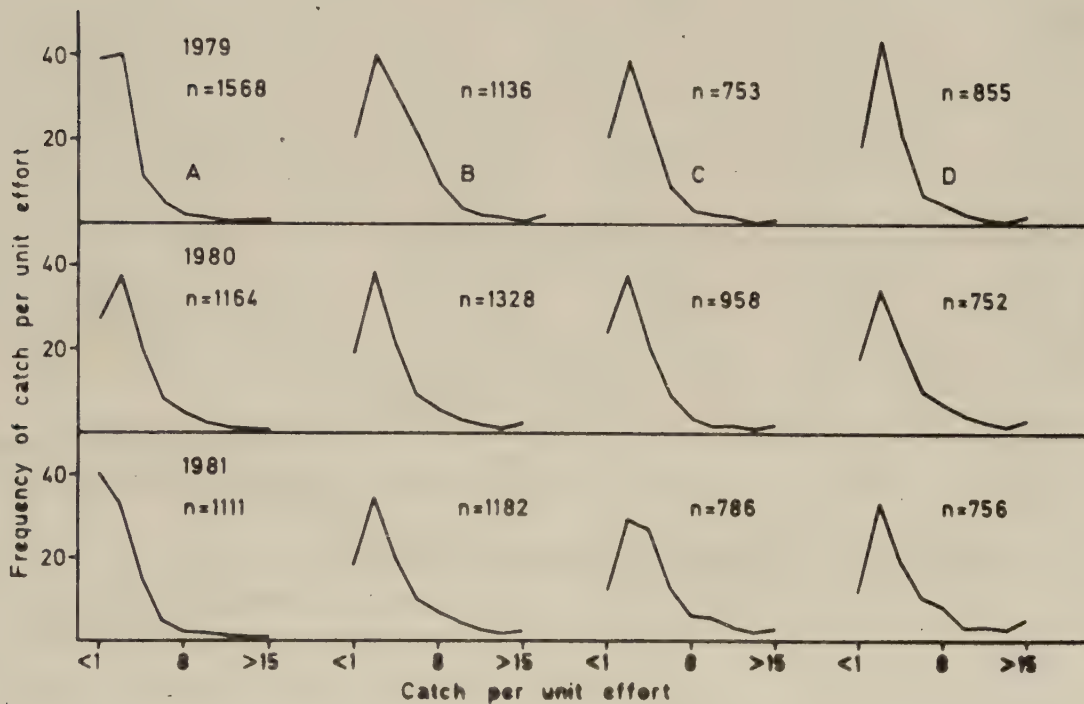


Fig. 2. Annual frequency distribution of sardine catch per fishing day in the eastern Adriatic, 1979-1981.

Taking into account the fact that sardine fishing is of seasonal character, seasonal frequency distribution of catch per fishing day was also analysed (Figs. 3, 4 and 5). The analysis shows that the skew to the right is increased as the fishing season approaches the third quarter when the highest percentages of lower catch values per day are obtained, i.e. the distribution of U values became more skewed to the right during summer months. Distribution of the fourth quarter looses to a certain extent this regularity. It is the time when sardine catch per fishing day is highest in all the observed areas. The total catch per individual areas shows differences with seasons. Thus it is highest in area A in summer, in areas B and D in autumn and in area C in spring.

The major amount of effort is expended in the area C in winter and somewhat less in the area B. At the beginning of spring a major part of purse-seine fleet leaves northwards since the area B is principal fishing ground. Greatest effort is expended there even though the greatest catches are realized in the area C with less effort, that is the catch per unit effort is very high in that zone. In summer the effort is highest in the area A wherefrom the largest total catch is obtained. In autumn about 50% of fishing days are realized in the area B.

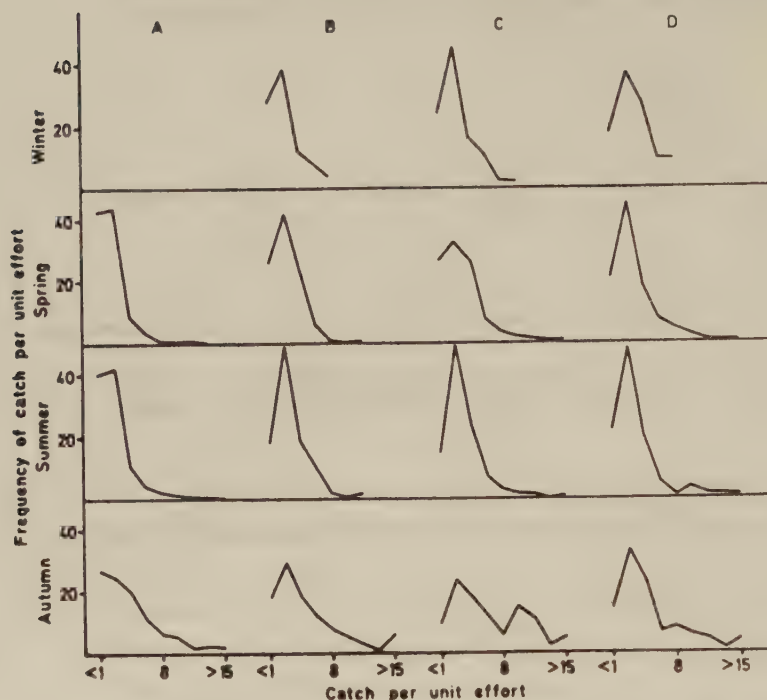


Fig. 3. Seasonal frequency distribution of U values in 1979.

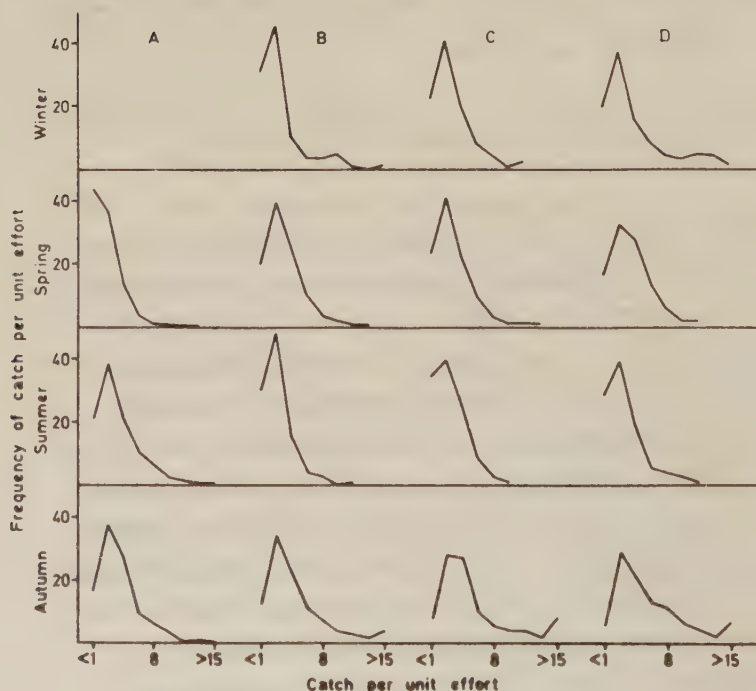


Fig. 4. Seasonal frequency distribution of U values in 1980.

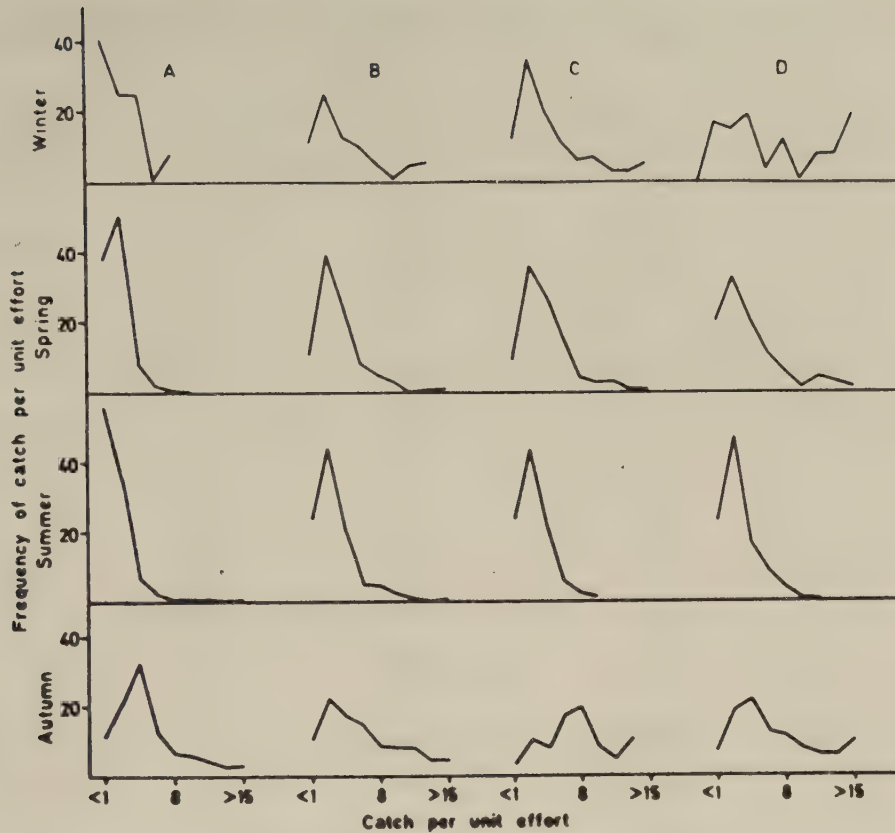


Fig. 5. Seasonal frequency distribution of U values in 1981.

Of the total number of effective fishing days the major part was realized in areas A and B: 66.4% in 1979, 59.9% in 1980 and 62.3% in 1981 (Fig.6). Seasonal variations of fishing effort by areas are given in Table 2.

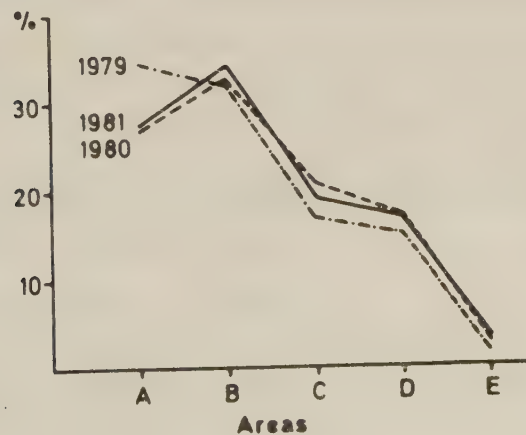


Fig. 6. Annual distribution of fishing effort in the eastern Adriatic, 1979-1981.

Table 2. Seasonal fishing effort distribution (percentages) in five fishing areas in the eastern Adriatic, 1979/1981

Year	Area	Winter	Spring	Summer	Autumn
1979	A	-	31.2	46.3	21.4
	B	16.0	28.9	25.9	53.4
	C	75.6	21.3	11.7	9.2
	D	6.4	17.2	13.9	15.1
	E	1.9	1.4	2.2	0.8
1980	A	-	25.4	40.8	22.5
	B	32.4	31.8	14.5	51.0
	C	49.0	25.1	20.1	9.2
	D	18.6	14.9	20.2	17.3
	E	-	2.8	4.4	0.9
1981	A	3.5	16.5	41.9	32.2
	B	15.2	37.8	28.7	45.8
	C	69.7	21.5	6.9	4.6
	D	5.8	21.4	18.4	15.0
	E	1.5	2.8	4.1	2.4

Calculated monthly means of catch per fishing day, according to the function $\bar{U} = \Sigma U/n$ are given in Fig.7a and b. The value $1/k$, that is the index of aggregation of sardine population, was calculated as a good indicator of changes in density in a defined season of the year. Lower values of $1/k$ and $\bar{U}$ correspond to the warmer months, from late spring to the month of September, in all five areas. The highest $1/k$ values were obtained in autumn-winter. The area A is an exception where no regularity is observed.

Variations of catch per fishing day are connected with the degree of fish concentration at different time of the year (Fig.7a and 7b) The test of their relationship (t - test) shows them to be significantly correlated. In this way, greater sardine aggregation explains to a certain extent (50%), the variability of U values (Table 3). However, it has been proved that the aggregation coefficient and fishing effort are inversely related but not significantly (Fig.8).

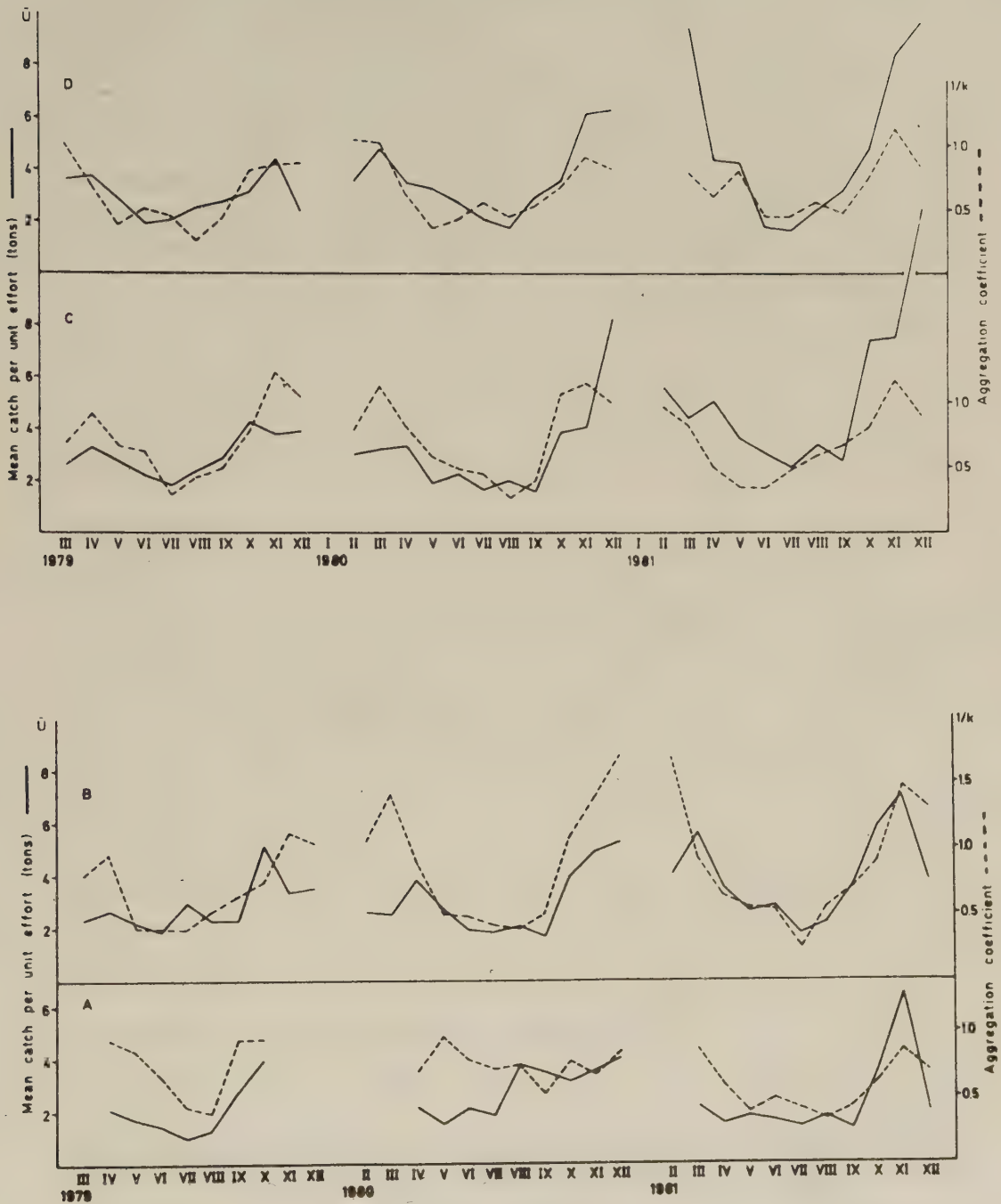


Fig. 7. Monthly variations of catch rate ($\bar{U}$) and aggregation coefficient ($1/k$) of sardine from the northern (below) and the middle (above) Adriatic fishing areas, 1979-1981

Table 3. Correlation coefficients of aggregation coefficient with mean catch per unit effort and fishing effort from four fishing areas of the eastern Adriatic

Area	Correlation coefficient					
	1979		1980		1981	
	$\bar{U}$	f	$\bar{U}$	f	$\bar{U}$	f
A	0.765*	-0.164	-0.376	-0.458	0.458	-0.399
B	0.497	-0.136	0.803*	-0.241	0.695*	-0.349
C	0.665*	-0.280	0.630*	-0.203	0.636*	-0.157
D	0.574	-0.862*	0.684*	-0.361	0.812*	-0.636*

*) significant at 95% level

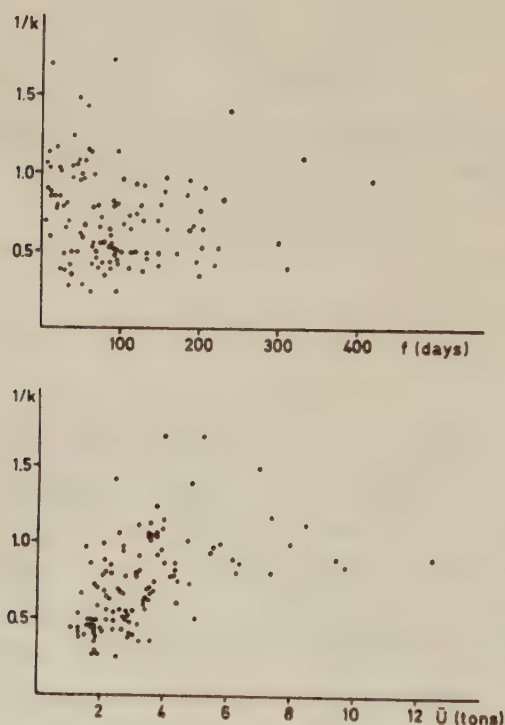


Fig. 8. Correlation between changes in mean catch per unit effort ($\bar{U}$) and fishing effort (f) and changes in fish concentration ($1/k$)

4. DISCUSSION

Frequency distributions of catch per fishing day of sardine caught by purse-seining along the eastern Adriatic are skewed and fit a negative binomial distribution with modal numbers corresponding to smaller values. These distribu-

tions are probably affected by characteristics of the fish species behaviour. Namely, spatial distribution of many pelagic fish species is contagious due to schooling. Bannerot and Austin (1983) proved that the distribution of U values becomes more skewed to the right as the population size decreases. This is consistent with an inverse relationship with catchability coefficient. It was observed that the catchability coefficient for the eastern Adriatic sardine is inversely related to the population size and that the catchability coefficient was reduced in the 1977-1979 period. Furthermore it was found that the sardine stock size in the eastern Adriatic showed an increase trend when the population state is analysed by the means of production models (Alegría, 1983, 1984). Similar result was obtained by egg surveys method (Regner et. al., 1984). The observations of U value distributions, which show the tendency of being less skewed right, are indicative of the increase of fish abundance.

It is characteristic for negative binomial distributions that the variance is greater than means. The comparison of these parameters allows an estimate of the level of heterogeneity of the catch which may show the heterogeneity of the population. Taylor (1953) studied the variability of catch of different fish species and found that the variance was proportional to the level of schooling of individuals within a population. Consistent with the obtained values of index $1/k$, the aggregation variations follow a well defined pattern, i.e. the sardine aggregation is particularly strong in autumn-winter, whereas between two periods of high schooling the population is dispersed in space.

In winter months the effects of weather conditions are reflected upon the catch per unit effort in all the areas, since the effort is considerably lower. Accordingly, the calculated abundance indices are liable to bias. Naturally, a large number of fishing days will diminish the bias of $\bar{U}$ values. But the majority of U values available for this period corresponds to catch realized in March. It is probable that the availability of stock is reduced during the most intensive species reproduction what accounts for the poor catches in January and February. In area A poor catches in winter may be due to purely commercial reasons since other pelagic species are intensively fished at that time, particularly anchovy and sprat.

5. REFERENCES

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ANNEX E (S)

Observations on the differences between sardine, *Sardina pilchardus* (Walb.) subpopulations from the eastern Adriatic

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With respect to somatic and some other differences within population, sardines are characterized as a polymorphic, and very probably also as a polytype species. After a number of statements (even though not all) Atlantic *S.p.pilchardus* subspecies shall be distinguished from the Mediterranean *S.p.sardina* subspecies. As to the biogeography, sardine species is a very significant boreal element of the Adriatic ichthyofauna.

The differences in meristic, morphometric, serological and some other characteristics between the middle Adriatic sardine and northern Adriatic sardine, and particularly the fact that these differences are relatively constant in these areas, lead us to suppose that sardine population was not homogeneous. Environmental differences are determined phenotypically discrete sardine populations in the study areas.

In this connexion, some relevant indicators of the differences between the middle Adriatic and northern Adriatic sardine are summarized. They include the differences in length structure, head length, vertebral number, gill raker number, spawning and exploitation areas and displacements. Some recent biochemical and physiological studies have established some apparent differences within the population of the northern Adriatic sardine.

1. Length structure

Differences in length structure of sardine samples from different Adriatic areas are obtained from mean and modal values of body length even though these characteristics may be affected by ecological factors. Large number of studies of length structure of sardine population from the eastern Adriatic have been carried out. The analyses of length of sardine from the middle Adriatic showed that this area was inhabited by the fish of 12 - 20 cm in length (Mužinić, 1954). Mean lengths ranged from 13.62 cm close to the coast to 17.20 cm in the vicinity of Vis and Biševo Islands. Comparing length structure of sardine samples from the western Istrian coast to those from the mid-Dalmatian area, caught at approximately the same distance offshore during autumn 1946, Mužinić (1958) reported the sardine

from middle Adriatic (modal length 16.0 - 16.5 cm) to exceed considerably in length the sardine from Istrian area (modal length 13.0 - 13.5 cm). Length of sardine from the Kvarner area varied between 12.1 and 19.3 cm in fishing season of winter 1960 to spring 1961 (Zavodnik, 1962).

Length of sardine from the commercial catch samples from the west Istrian coast in 1970 - 1973 varied from 12 to 20 cm with the mean varying from 15.70 to 16.92 cm what lead Žikić and Krajnović-Ozretić (1976) to conclude that this sample had to a certain extent, a heterogeneous structure. At the same time, these authors obtained mean length of 18.11 cm for a sardine sample from the Vis Island which was much more homogeneous. This mean value considerably exceed that of sardine from the west Istrian samples.

Length structure of commercial catch samples from autumn winter of 1980-1981 showed the length range of 100 to 195 mm, characteristic number 151.97 as mean, and 145 modus for the northern Adriatic sardine, and 120 to 210 mm, mean 165.07 mm and modal length 170 mm for the individuals from the middle Adriatic (Alegría, 1981). Comparison of these results (Fig.1) is indicative of an obvious difference in sardine length between these two areas. It should, however, be taken into consideration, that the changes in length structure of samples is probably due to the effects of population migrations.

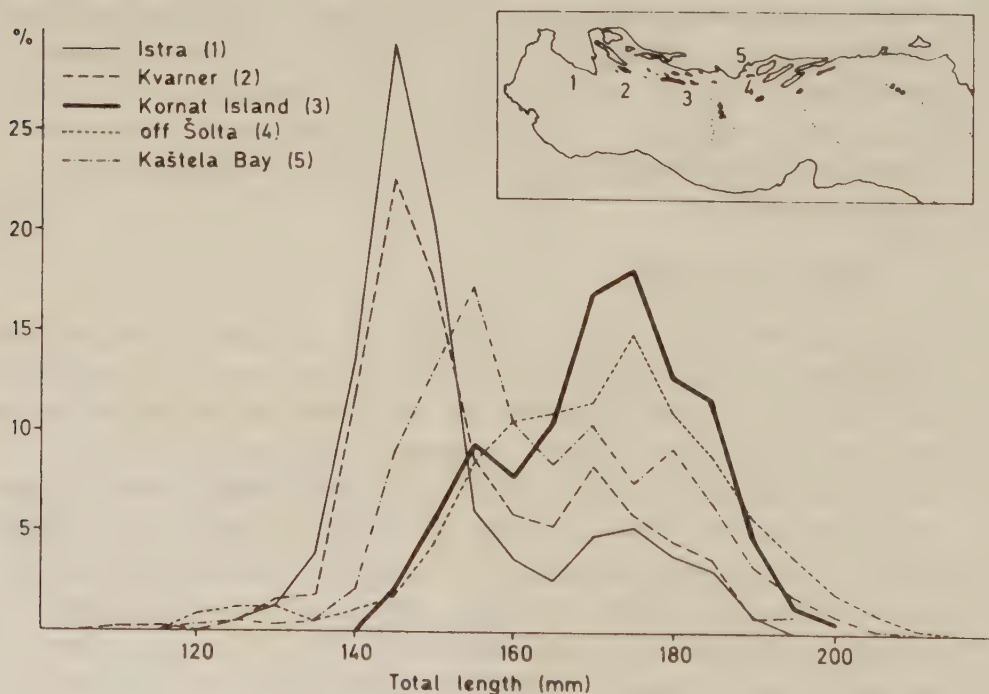


Fig. 1. Length frequency distribution of sardine samples from five areas of the eastern Adriatic, 1980-1981.

2. Head length

Data on the variations of sardine head length in relation to body length are very scarce. Alegría (1983) compared the sardine samples from the northern to those from the southern Adriatic (Fig. 2) and concluded that, in spite of the fact that the head growth is almost isometric in relation to fish length, the rate of the head growth of sardine from the northern Adriatic was lower. Differences in cephalic indices between two areas were not significant irrespective of the fact that the body length ranges were different.

Similar relations were established from the samples of the same length ranges of 125 to 195 mm (Alegría 1985). Statistical values which describe two exponential regressions are as follows.

Area	Mean	a	b	$s^2_{x.y}$
Northern Adriatic	30.45	0.289	0.934	2.15×10^{-5}
Middle Adriatic	32.32	0.237	0.937	0.24×10^{-5}

The obtained indices of head growth were not significantly different. However, variability of this character is much greater in sardine from the northern Adriatic. On the basis of mean regression values and respective common standard deviation of the regression, Alegría estimated that these two sardine groups showed an overlap of 93%.

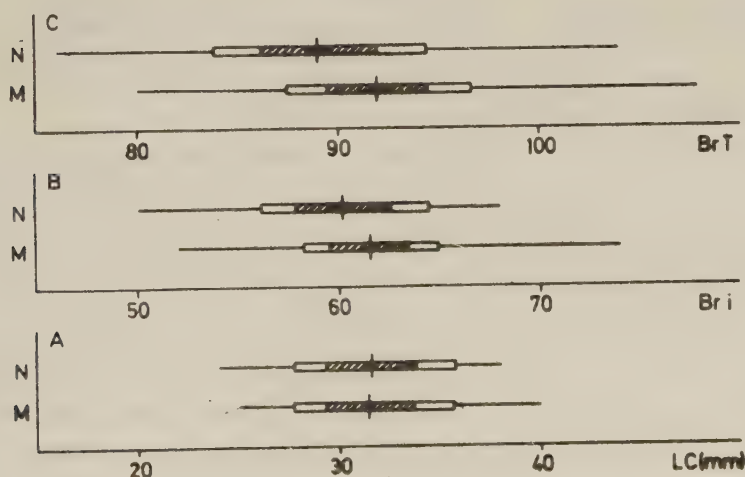


Fig.2. Statistics of head length (A), cerato-hypobranchial gill rakers (B) and total number of gill rakers (C). Horizontal line is the total range of variation and the vertical one is the mean. The hollow, the shaded and the black portion of the bar respectively represent one standard deviation, one standard error and one standard error in relation to the length on each side of the mean.

3. Vertebral number

A number of authors studied the heterogeneity of the Adriatic sardine population with respect to the vertebral counts. Fage (1920) published the results of the first observations of vertebral numbers in the northern Adriatic sardine and found two modal values: 51 and 52. Zavodnik (1962) obtained similar results for the sardine from Kvarner. The analyses of samples from the northwestern Adriatic coast (Mozzi and Duò, 1968) showed far greater heterogeneity in vertebral counts. Majority of samples showed modal values between 50 and 51 with much greater variability amplitudes. Authors assume that the modal number 51 is characteristic for the northern Adriatic sardine and 52 for the middle Adriatic sardine population. Using the samples from the west Istrian coast in fishing season of 1946, Mužinić, R. (1954) obtained modal value of 52 vertebrae, but with highly represented number 51. Modal number 52 was established also for two samples from the northwestern Adriatic coast.

Mužinić suggested that the occurrence of a mode at 51 in the northern Adriatic sardine was indicative of a considerable variability in the number of vertebrae due probably to a relatively strong mixing of two subpopulations from the northern Adriatic. The analysis of sardine samples from the northern Adriatic in the 1969-1973 fishing season showed modal number 52 with the exception of one sample with the modus 51 (Krajnović-Ozretić and Žikić, 1978). Results of these studies were tested by F-test by which the authors proved the homogeneity of the northern Adriatic sardine population.

Mužinić, S. (1936) established the mode at 52 and mean 51.653 for the sardine from the middle Adriatic. The later studies on the group of samples proved the modal value 52 with means varying from 51.625 to 51.728 (Mužinić, R., 1954).

The above mentioned values show very pronounced bimodality of vertebral counts. Variability gradually decreases in samples from the north to the south. Therefore, and from a large number of data from the paper by Mužinić (1954) means of vertebral numbers of sardine from 9 areas along the eastern Adriatic coast were tested as well as the mean for Venice:

Table 1. Summary of vertebral number data of sardina from different areas of Adriatic Sea (after Mužinić, 1954)

No.	Zone	N	Mean	St.dev.
1	Venice	436	51.764	0.615
2	Istra	416	51.631	0.582
3	Susak	154	51.643	0.610
4	Dugi otok	165	51.788	0.601
5	Kaštela Bay	845	51.696	0.595
6	NW Hvar Island	507	51.688	0.574
7	Vis-Biševo	697	51.618	0.578
8	Palagruž	357	51.706	0.560
9	Budva	265	51.694	0.529
10	Vlora	265	51.502	0.571
Correlation coeff.			-0.086	-0.799

Variance correlation with respect to geographical distribution, was significant at the 95% level. Accordingly, the homogeneity of group variances was tested. Test results showed significant heterogeneity of variance. Games and Howell method for samples with heterogeneous variances was used for testing of significance of differences between means. It was shown that the differences between means for all groups were not significant with the exception of the sample from Vlora. The number of vertebrae of this group differs considerably from that of the majority of other groups even though the modus found for this groups was also 52.

Nevertheless, it was observed that the variance in the number of vertebrae showed a certain latitudinal cline which may be indicative of the stabilization of this character in compliance with ecological conditions of the environment.

4. Number of gill rakers

The number of gill rakers in sardine, like in other *Clupeidae*, is of markedly neotic character, i.e. their number is increased with the body length. Studies of gill rakers of sardine is usually concerned with the determining of their number on the cerato-hypobranchial component of the first branchial arch. Several papers dealing with this meristic character in the Adriatic sardine are available. Regan (1916) found 50-60 gill rakers in fish of 110 to 180 mm in length. This author believed that, in general, the Mediterranean sardine have less than 60 gill rakers on the lower limb of the first branchial arch. Andreu (1969) found that this number varied from 46 to 62 in 105-165 mm long sardine from the middle Adriatic. He calculated the value of 0.291 as the rate of increase of cerato-hypobranchial gill rakers.

Studies of cerato-hypobranchial gill rakers of sardine from the northern and middle Adriatic samples (Alegría 1983) showed the following results:

Characteristics	Northern Adriatic	Middle Adriatic
Length range	120 - 195	125 - 205
Gill raker numbers range	50 - 68	52 - 74
Mean number of gill rakers	60.20	61.82
Modal number of gill rakers	58	62
Rate of increase	0.503	0.394

On the basis of the significant difference in the rates of increase in the number of gill rakers, this author assumed that certain physiological difference exists between these two sardine groups in spite of the effects of length changes on the variations in the number of gill rakers.

The differences in the mean number of gill rakers and the rate of gill raker number increase between different localities are rather marked. Alegría (1985a) summarized the data on the number of gill rakers in sardine from five Adriatic areas in the following manner:

Area	N	Total Length range	Gill raker mean number	Gill raker increase rate	$s_{y.x}^2 (x10^{-5})$
Istra	520	130 - 190	90.211	0.4303	1.52
Kvarner	420	125 - 195	89.626	0.4624	3.71
Kornati Islands	261	145 - 195	94.466	0.4221	2.87
Kaštela Bay	815	135 - 200	93.575	0.3966	1.42
off Šolta	264	145 - 195	94.252	0.4030	1.01

It was thus proved that the mean number of gill rakers increased southwards. Comparing the stocks of adjacent areas this author found the nosignificant difference in the number of gill rakers. However she took it possible to distinguish two populations out of the five analysed groups since the overlap of distribution of the number of gill rakers showed the following pattern between adjacent areas:

Istra - Kvarner 78.72% ; Kornati Islands - Kaštela Bay 64.56%; Kornati Islands - off Šolta 87.28% and Kaštela Bay - off Šolta 66.0% ; but Kvarner - Kornati Islands only 34.0%. Percentages of overlap for distant areas were very low (about 5%) and not significant.

Alegría (1985) reported on the variations of the number of gill rakers of sardine of a defined length structure (125 - 195 mm total length) (Fig. 2).

The following characteristic values were obtained by functional regression:

Area	Corr. Coeff.	a	b $\pm$ s _b	s ² _{y.x}
Northern Adriatic	0.956	1.0043	0.4296 $\pm$ 0.0461	2.42 x 10 ⁻⁵
Middle Adriatic	0.978	1.5700	0.3666 $\pm$ 0.0294	0.98 x 10 ⁻⁵

Test of equality of regression slope and critical difference between rates of increase of the number of gill rakers gave significant difference at the level of 95%. The covariance analysis showed significant difference between groups, but not within groups.

However, Alegría held that there were some indications of the stabilization of this character in the sense of smaller rate of increase of gillraker numbers and smaller variance. This is in agreement with the conclusions of Andreu (1969) who assumed that lower rates of increase in gill raker numbers are characteristic for sardine populations from the regions of stable hydrographic conditions.

The overlap in latitudinal distribution of the gill raker numbers in sardine (43.8%), calculated directly from the sample, showed the presence of two sardine populations in the eastern Adriatic.

5. Biochemical-physiological characteristics

Biochemical-physiological observations of the Adriatic sardine started in 1965, have been carried out only in the northern Adriatic and therefore no comparison is possible with these properties in the middle Adriatic sardine.

Krajnović (1969, 1975) carried out the immunogenetic studies by means of tests of reaction of erythrocyte antigens with human sera (A and B) on the sardine caught along the west Istrian coast during spawning seasons of 1965 and 1966. Results of erythrocyte agglutination reactions showed that erythrocytes of sardine from the northern Adriatic possess at least one antigen distinct from human antigens (A and B). This sardine one was called "C". Quantitative studies of frequency of antigen "C" in tested catch samples showed considerable differences and accordingly the presence of at least two distinct sardine groups in the study area. Similar serological studies on sardine from the same area in 1965-1967 spawning seasons with the application

of human (A and B), rabbit and goat sera (Krajnović, 1968, 1975) pointed also to the differences between the tested samples. Namely, a sardine group was identified which did not react contemporaneously with the used test sera (ABRG - positive group). Frequency of this group differed from one catch sample to another. At least two groups were obtained in this sense. The first group was characterized by low frequency of about 2.6% ABRG-positive sardines and the second group with the frequency of 42.1% ABRG-positive sardines. In addition to mentioned groups the samples obtained from two catches showed extremely high value of ABRG-positive sardines (81.9%). However, it is difficult to take for granted that a third group may be present since only two samples were available.

The existence of antigen "C" and the so called ABRG-positive reaction are indicative of the presence of two serologically distinct groups of sardine from the northern Adriatic what was attempted to be accounted for by their different spawning populations.

Electrophoretic analyses of hemoglobin of sardine from the northern Adriatic showed a single electrophoretic pattern with two components. The hemoglobin of only three specimens showed a three-component pattern which was supposed with respect to the large number of tested specimens and low frequency of third component, to be rather due to the "abnormal" hemoglobin (Krajnović, 1968a).

6. Spawning areas

Gamulin (1954, 1954a) first gave a general picture of sardine spawning areas along the eastern Adriatic coast from egg distribution in plankton during the spawning seasons 1947-1950. Two spawning areas were particularly marked: in the area of the island Dugi otok in the northern Adriatic and in the mid-Dalmatian channel area and Palagruža area in the middle Adriatic. Third less marked centre of spawning was recorded from the area of Bar in the southern Adriatic, which was also recorded by Karlovac, J. (1955) but somewhat more south in the waters of Albania. It was also observed that the northern Adriatic sardine spawning centre was separated from the middle Adriatic one by permanently negative area of the Jabuka Pit.⁺ Some more recent studies of sardine egg distribution in the plankton during the spawning time carried out over a wider area (Piccinetti et al., 1980, 1981; Gamulin and Hure,

⁺In some years, when the sardine biomass during intensive spawning is great, relatively high quantities of eggs happen to be recorded from the Jabuka Pit (Casavola et al., 1985, in press) and the spawning areas overlap.

1983) established that there were two marked centres of sardine spawning in the Adriatic, in the northern and middle parts, separated from each other by the Jabuka Pit, but they include much wider area than it was held earlier (Fig. 3). Spawning area north from the Jabuka Pit stretches during intensive reproduction from the Italian coast (Pesaro-Ancona) along the central part including Kvarner (Unije Island) and spawning ground near the island Dugi Otok. The spawning area south from the Jabuka Pit stretches from the mid-Dalmatian archipelago over Palagruža to the Apennine Peninsula and along the Apennine Peninsula southward to the Otranto Strait (Gamulin and Hure, 1983).

The spawning area in the middle Adriatic has been studied in more detail (Gamulin, 1948; Gamulin and Karlovac, J., 1956; Karlovac, J., 1964, 1969 etc.). Two parts may be distinguished, the area of mid-Dalmatian islands and a part of the open sea and the area of Palagruža, separated by the Palagruža Sill. During the intensive reproduction these two spawning areas are united into one area, the mid Adriatic spawning centre of sardine.

According to the researches carried out so far, particularly to the more recent ones, it may be stated that sardine spawn all around the continental slope, with higher concentrations in above mentioned spawning areas, which show considerable variations in time and space. No spawning areas were found in shallow areas near the estuaries of the north Italian rivers, in the Jabuka Pit and South Adriatic Pit.

The Jabuka Pit by its great depth, and probably due to some still unknown ecological factors, is an effective barrier to the intermingling of these two distinctly segregate subpopulations. This barrier, particularly as far as reproduction is concerned, causes an isolation of subpopulations that is an obstacle for the exchange of their genetic material and is most probably the cause of a large number of observed differences.

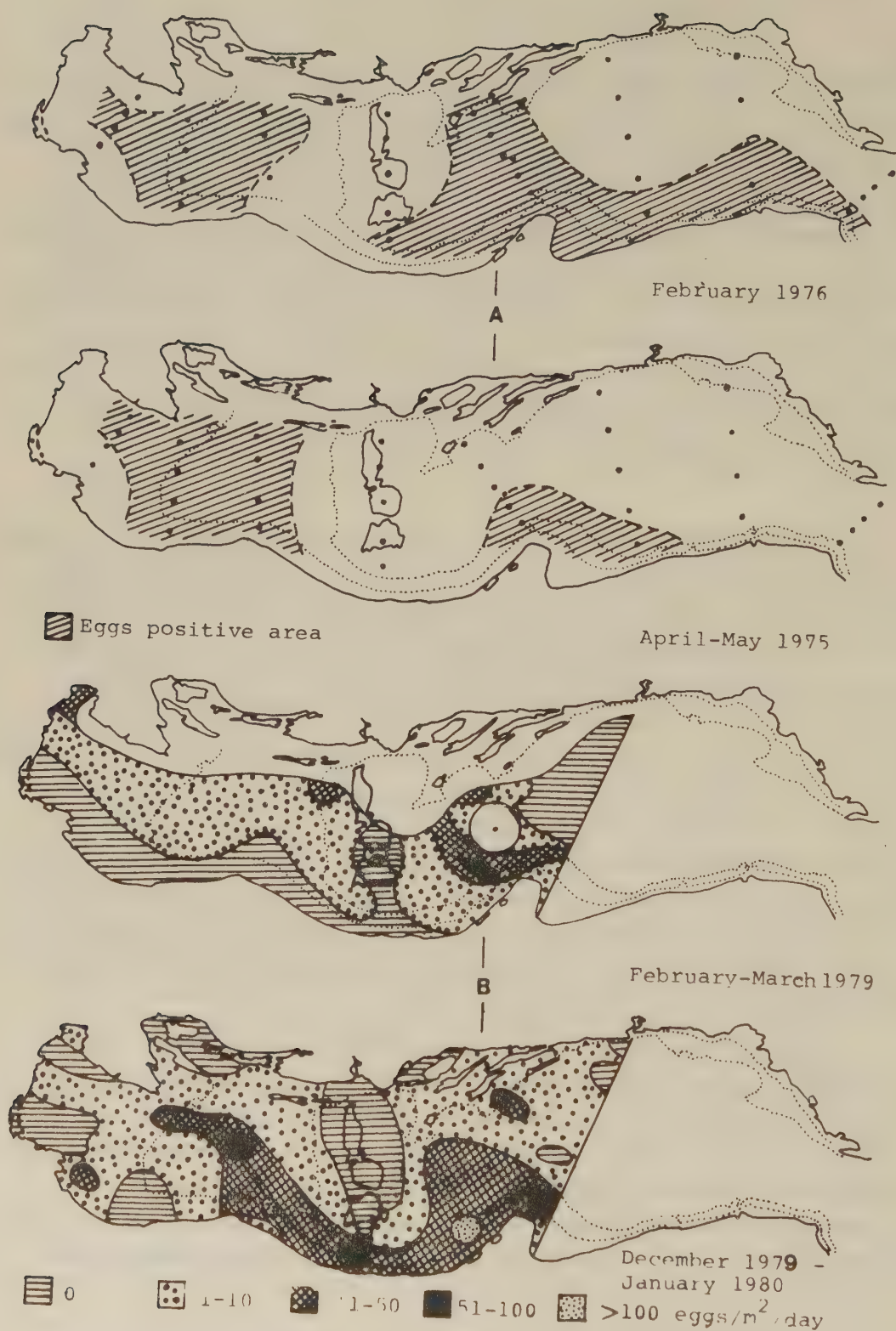


Fig. 3. Distribution of sardine eggs in the plankton during the period of intensive spawning. A - according to Gamulin and Hure (1983), B - according to Piccinetti et al. (1980).

7. Areas of exploitation

Even though sardine fishing grounds extend uninterruptedly from Koper to Ulcinj, they are not evenly distributed (Grubišić, 1964). Two concentrated groups round two centres are clearly distinguished. The first group includes the mid-Dalmatian fishing grounds, extending from the island Žirje in the north to the island Šipan in the south with the centre in the Vela Luka area. The second group includes the north-Dalmatian islands and Kornati archipelago together with the fishing grounds of Kvarnerić, Kvarner and Istra, with the centre round the island Unije.

The coincidence of distribution of fishing grounds with spawning areas is apparent, as well as the fact that they both are separated by the Jabuka Pit. This is also indicative of the fact that two Adriatic sardine subpopulations are separated during the reproduction as well as during their vegetative stage and accordingly are separately exploited.

8. Migrations

In the northern Adriatic after the fishing season is over autumn, sardine reproductions starts at about 17-18°C to be discontinued in winter due to the temperature decrease down to less than 10°C. Namely, sardine withdraw southwards to the wellknown spawning areas in the area of Susak - Dugi otok (Gamulin, 1964; Štirn and Kubik, 1974, Škrivanić and Zavodnik, 1973). At the beginning of spring when the sea temperature rises to about 15°C a part of sardine returns to the area of Kvarner and a major part to the Istrian waters.

Distinct from this longitudinal migrations of the north Adriatic sardine, the middle Adriatic sardine travel mainly in a transverse direction, that is from the coast offshore during spawning time and from the open sea (round Biševo Island) onshore to the coast or inner parts of channels among islands after spawning (Mužinić, 1949, 1950, 1952, 1954 etc.) (Fig. 4).

It has been recently proved that the sardine distribution is strictly discontinued at the position between the Kornati archipelago and mid-Dalmatian islands that is in the Jabuka Pit and that these two subpopulations, particularly during the colder part of the year during spawning, are not intemingled (Štirn and Kubik, 1974).

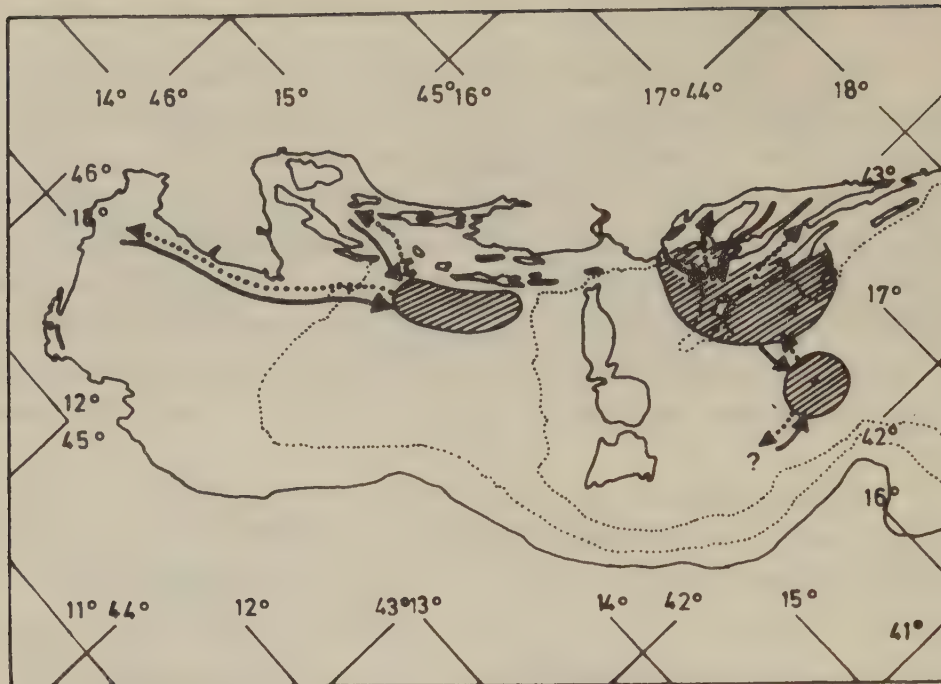


Fig. 4. Scheme of spawning areas and main hypothetical migrations of sardine along the eastern Adriatic coast (according to Štirn and Kubik, 1974).

CONCLUSIONS

- A number of studies based on the analyses of catch structure with respect to the total length have shown that sardine from deep waters exceed in length those from shallow waters. The differences of length structures lead us to conclude that sardine from the northern Adriatic are smaller than those from the middle Adriatic and that the individuals from the open sea exceed in length those from the coastal areas. This statement cannot be easily explained on genetic basis.
- Head length and vertebral numbers are somatic characteristics most frequently used for differentiation of sardine population. Small differences in head length and in cephalic indices as well as in vertebral counts do not point out the heterogeneity of the Adriatic sardine population. However, head length growth and vertebral counts vary less in sardine from the middle Adriatic with a pronounced cline in north-south direction. These facts indicate a tendency of stabilization of this character in the middle Adriatic sardine.
- The difference in the rate of increase of the number of gill rakers was proved to be significant between sardine from the northern Adriatic and sardine from the middle Adriatic.

Variability of this character is decreased with the decrease of the rate of increase of the gill raker number what is another evidence of the heterogeneity of the population. A relatively low value of overlap of the numbers of gill rakers in sardine is also indicative of the fact that at least two different sardine populations co-exist in the eastern Adriatic.

- Spawning centre of the north Adriatic sardine subpopulation is located north from the Jabuka Pit, primarily in the wider area of the island Dugi otok and the centre of spawning of the middle Adriatic sardine south from the Jabuka Pit, in the open part of the mid-Dalmatian island area and in the area of Palagruža. Jabuka Pit acts as a sharp boundary between these two spawning areas and as a barrier for the exchange of genetic material (reproductive isolation).
- Exploitation centre distribution is similar to the reproduction centre distribution of the two sardine subpopulations with the boundary area in the Jabuka Pit. This points to the separate exploitation of these two subpopulations.
- Migrations are of local character within the areas inhabited by the respective subpopulation. Migrations of the northern Adriatic sardine, which are longitudinal, extend to the island Dugi Otok, while the migrations of the middle Adriatic sardine are of transversal character from the coast and channels offshore and vice versa.
- In addition to these very apparent morphological (morphometric and meristic), ecological and ethological differences between the northern Adriatic sardine subpopulation and middle Adriatic sardine subpopulation there were established also the biochemical-physiological differences within the northern Adriatic subpopulation. This lead us to conclude that at least two sardine groups are present in the northern Adriatic.
- Boundary areas of the Jabuka Pit, that is its north-aestern and southwestern edges are very probably the areas of mixing of two Adriatic sardine subpopulations in fact their characteristics (morphometric and meristic in the first place). However, since these overlaps of subpopulations are present in a very limited area in relation to the areas of distribution of these subpopulations, they are not of any greater importance even though it was shown that in the areas of mixing of subpopulations the characters of the middle Adriatic subpopulations are predominant.

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ANNEX (E) T

Considérations sur la distribution des clupeiformes *Engraulis encrasicolus*
et *Sardina pilchardus* en Adriatique

par

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Les petits poissons pélagiques ont toujours constitué une ressource très importante pour les pêcheurs de l'Adriatique. De nombreuses recherches ont été conduites par les différents laboratoires de Yougoslavie et d'Italie sur les différents aspects biologiques des principales espèces. Très récemment les recherches ont été étendues à toute l'Adriatique dans le cadre d'une collaboration entre les laboratoires de Fano, de Split et de Trieste (Laboratorio di Biologia Marina e Pesca (Fano), Institut Za Oceanografiju i Ribarstvo (Split), Dipartimento di Biologia (Trieste). En particulier, depuis 1976, on a étudié la distribution quantitative des oeufs de l'anchois et de la sardine dans le but d'estimer la biomasse des reproducteurs et d'augmenter les connaissances sur la saison et sur les lieux de ponte. Plus récemment Gamulin et Hure (1983) ont présenté les résultats d'une série de campagnes étendues au sud de l'Adriatique qui indiquent la distribution des oeufs et les aires de ponte de l'anchois et de la sardine.

Les résultats montrent que l'anchois et la sardine ont une aire de ponte étendue à presque toute la haute et la moyenne Adriatique et que cette zone de ponte s'étend aussi dans le sud de l'Adriatique. Pour une estimation correcte de la biomasse des reproducteurs il est nécessaire de connaître la quantité totale d'oeufs pondus par la population dans toute la zone de ponte.

Jusqu'à 1983 les recherches faites par les laboratoires de Fano, Split et Trieste ont considéré comme limite meridionale de la distribution des populations la ligne Gargano-Kotor, à cause des difficultés d'étendre la recherche au sud et des différences hydrologiques et écologiques dans cette partie de l'Adriatique. La ligne Gargano-Kotor correspond en outre à la limite de la sous-zone statistique 37/4 du CGPM.

L'existence d'une zone de ponte pour l'anchois et la sardine au sud de cette ligne a rendu nécessaire l'étude de la continuité éventuelle entre les aires de ponte situées au nord et au sud du Gargano et de l'importance relative de la reproduction dans ces deux zones.

C'est pourquoi une recherche financée par le Ministère de la Marine marchande (direction générale des Pêches) a commencé en 1984 étendue à toute l'Adriatique d'Otrante jusqu'à Trieste. Cette recherche se poursuivra jusqu'en 1986.

Les méthodes d'échantillonnage et de traitement des données ont été standardisées et sont pareilles à celles qu'on a déjà utilisées au cours des précédentes recherches (Piccinetti et Specchi, 1979). Les résultats qu'on présente ici dérivent de deux campagnes réalisées en juillet 1984 et mars-avril 1985 respectivement pour l'anchois et pour la sardine. Les données sur la saison de ponte seront élaborées par la suite.

Dans la figure 1 est indiquée la distribution des oeufs d'anchois. Les oeufs sont plus abondants dans la haute Adriatique. L'absence des oeufs en dehors du plateau continental est aussi évidente. On peut noter la continuité de l'aire de ponte le long de la côte italienne entre le Gargano et Brindisi. L'absence d'oeufs en face d'Otrante confirme ce que Gamulin et Hure (1983) avaient déjà vu et pourrait indiquer la limite sud de l'aire de ponte de la population adriatique de l'anchois. Comme on l'avait déjà dit, la distribution des oeufs d'anchois

est limitée à une bande côtière limitée à peu près à l'isobathe 200 m. L'estimation de la quantité d'oeufs pondus entre le Gargano et Otrante comparée avec la quantité pondue dans la partie au nord du Gargano ne peut pas être faite sans considérer la distribution de la ponte dans la saison entière, mais il est évident que les estimations de la biomasse des reproducteurs faites jusqu'à présent et qui ne prenaient pas en compte l'aire située au sud du Gargano, doivent être considérées comme des sous-estimations.



Figure 1 - Distribution des oeufs d'anchois.

Pour ce qui se réfère à la sardine les résultats de la campagne de 1985 sont indiqués dans la Figure 2. L'aire de ponte de la sardine est très étendue. Les aires à densité d'oeufs plus élevée se trouvent au large dans la zone médiane de l'Adriatique. L'aire de densité maximale se déplace, comme l'avaient déjà observé plusieurs auteurs. Quelque fois on peut observer deux ou plusieurs zones d'abondance des oeufs. Au sud du Gargano il y a des zones à densité élevée d'oeufs ce qui laisse supposer une haute intensité de ponte. Il semble donc que l'importance de la reproduction dans l'Adriatique sud ne soit pas négligeable et que cette zone puisse apporter une certaine contribution à la biomasse de la sardine adriatique.



Figure 2 - Distribution des oeufs de sardine.

D'une façon générale on peut dire que:

- pour l'anchois comme pour la sardine il y a une continuité de l'aire de ponte entre le sud et la moyenne Adriatique.
- l'importance quantitative de la ponte dans le sud de l'Adriatique est différente entre les deux espèces et semble plus importante pour la sardine que pour l'anchois.
- toute estimation de la biomasse des petits poissons pélagiques effectuée sur une seule partie de l'Adriatique peut amener à des sous-estimations sensibles du stock, indépendamment des méthodes utilisées.

ANNEX (E) U

Some preliminary results on the length-weight relationship in sardines
(*Sardina pilchardus* Walb) in the southern Adriatic in the spawning season

by

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This paper analyses the length-weight relationship of sardine in the autumn-winter season (November 1984-March 1985), along the Albanian coast at a depth range of 30-120 m. A number of 1093 sardines caught by pair trawls was analysed. The sardine spawns at this period of the year and the physiological conditions for all fish are the same. Their length was measured in millimetres and the fish were grouped in length classes with a precision of 0.5 mm, each sex separately and both sexes together. Weight was measured with a precision of 0.1 g and the mean weight was calculated for each length class (the data are given in Table 1).

Table 1 - Length and average observed weight of females, males and both sexes

L (mm)	W (g)	W (g)	W (g)
	♀	♂	♀♂
125	12.36	12.84	12.63
130	13.92	14.51	14.34
135	15.52	15.1	15.12
140	17.23	16.41	16.52
145	17.67	18.42	18.38
150	22.17	20.29	21.44
155	23.35	22.16	22.69
160	24.45	24.3	24.38
165	27.82	26.94	27.55
170	30.32	29.35	30.01
175	33.46	33.0	33.34
180	35.87	35.5	35.71
185	38.5	37.26	38.02
190	42.05	40.02	40.96
195	44.91		44.91

The length/weight relationship was represented by the equation:

$$W = a L^b$$

where:

W = weight in g.

L = total length in mm.

b = length-weight factor

a = constant

The condition cubic factor was calculated by the equation:

$$K = WL^{-3}$$

The empirical condition factor was calculated by the equation:

$$c = WL^{-b}$$

The length-weight relationship was calculated by the method of least squares, on the basis of length and weight data obtained by the measurement shown in Table 1.

The following fuctions express this relationship:

$$\begin{array}{lll} \text{Females} & W = 1.156 \times 10^{-5} \times L^{2.8765} & r = 0.9286 \\ \text{Males} & W = 1.182 \times 10^{-5} \times L^{2.8662} & r = 0.9225 \\ \text{Total} & W = 1.171 \times 10^{-5} \times L^{2.8708} & r = 0.9171 \end{array}$$

The theoretical weights of the fish of different lengths were calculated by means of the above equations and are given graphically in Figure 1.

Calculation of the empirical condition factor gives the following results (See also Table 2).

$$\begin{array}{ll} \text{Females} & C \times 10^5 = 1.156 \\ \text{Males} & C \times 10^5 = 1.182 \\ \text{total} & C \times 10^5 = 1.171 \end{array}$$

Table 2 $C \times 10^5$ Empirical Condition Factor

L (mm)	♀	♂	♀♂
125	1.148	1.234	1.207
130	1.168	1.266	1.224
135	1.128	1.183	1.158
140	1.113	1.158	1.140
145	1.133	1.176	1.173
150	1.220	1.175	1.214
155	1.169	1.168	1.168
160	1.117	1.170	1.147
165	1.163	1.187	1.186
170	1.164	1.188	1.212
175	1.181	1.229	1.198
180	1.168	1.219	1.179
185	1.138	1.183	1.176
190	1.168	1.177	
195	1.162		

The cubic condition factor (K) was calculated for each class separately (Table 3).

Table 3 $K \times 10^5$ Cubic Condition Factor

L (mm)	♀	♂	♀♂
125	0.633	0.657	0.646
130	0.640	0.660	0.653
135	0.615	0.614	0.614
140	0.604	0.598	0.602
145	0.613	0.604	0.603
150	0.657	0.601	0.635
155	0.627	0.595	0.625
160	0.597	0.593	0.595
165	0.619	0.600	0.613
170	0.617	0.597	0.611
175	0.624	0.616	0.622
180	0.615	0.608	0.612
185	0.608	0.588	0.600
190	0.611	0.571	0.597
195	0.606		0.606
Mean	0.619	0.607	0.616
Standard deviation	0.0154	0.0243	0.0176

These functions are also given graphically (Fig. 2). It results from the above data that in the same length class sardines of southern Adriatic are smaller in weight than those of the central and northern Adriatic.

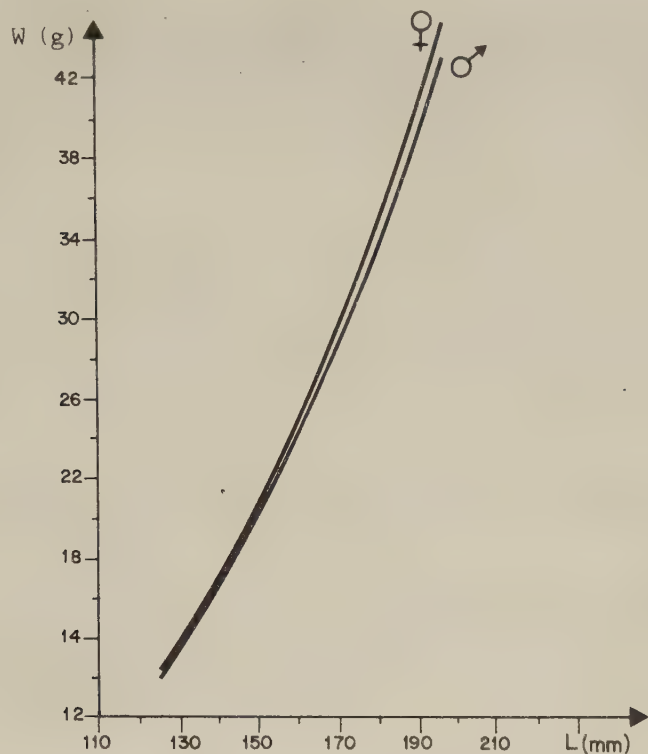


Figure 1 - Length|weight relationship

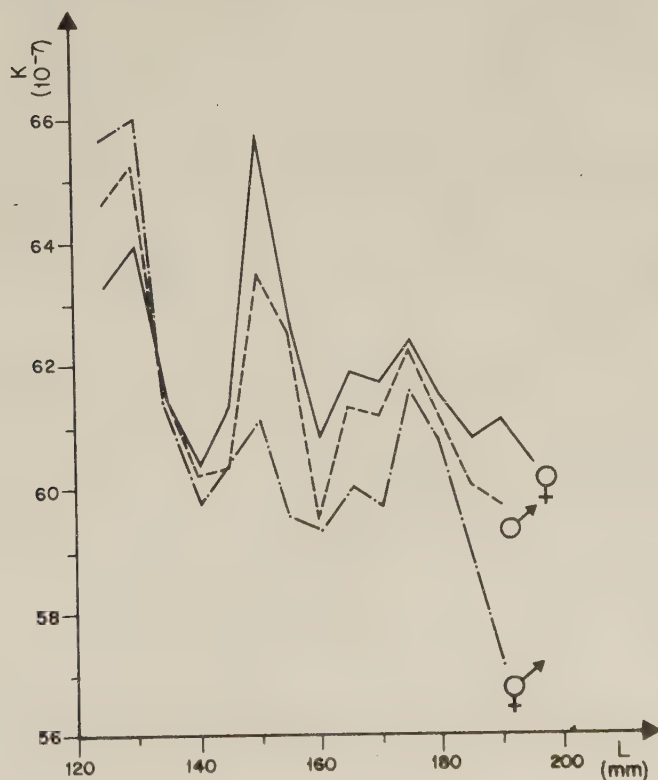


Figure 2 - Cubic condition factor as a function of length (data from table 3).

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ANNEX (E) V

On the structural characteristics of the sardine schools
(*Sardina pilchardus* Walb) along the Albanian Adriatic coast
in the winter period

by

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The geographical parametres of sardine schools assessed by acoustic methods were investigated in the winter period (November - March), which corresponds to their spawning season. In that period of the year the sardine accounts for nearly 60 per cent of the total catch of industrial fishing. The aim of this paper is to determine the probable relationship between school structure and species.

Analysis was made of the recordings of two pair fishing trawlers of the type 35 x 19 m, with mesh size of 400 mm (knot to knot) in the period from November 1982 to March 1983 (302 schools) and November 1983 to March 1984 (237 schools).

The fact that sardines constitute 95 per cent of the total catch of these vessels in this period clearly shows the accuracy of the determination of the species. The records have been made in the days when pair fishing is carried out, and cover a zone of 30-100 m depth, parallel to the coast. In both cases the "Simrad" echosounder of the "Skiper-802" type, with ferrit transductor, and a beam angle of 19° was used.

The heights of the schools were measured directly from the echogrammes, whereas their width and volume were computed by a method elaborated by Johannesson (1973). Distance between schools and sea-bottom was also measured directly by echogramme, as it is a significant parametre for pair fishing. Regarding height, over two successive years three classes were well distinguished:

- Up to 3 m: 125 schools (41 per cent) and 131 schools (55.3 per cent) respectively, or 256 schools for the two years taken together (47 per cent);
- From 3 to 5 m: 110 schools (36 per cent) and 65 schools (27.4 per cent) respectively, or 175 schools (32.5 per cent) for the two years taken together;
- From 5 to 8 m: 52 schools (17 per cent) and 30 schools (12.6 per cent) respectively, or 82 schools for the two years taken together (15.2 per cent).

The results are given in Tables 1, 2, 3 and 4.

Height (m)		1982-1983		1983-1984		Total	
From	Up to	Quantity	%	Quantity	%	Quantity	%
0	3	125	41	131	55.3	256	47.5
3	5	110	36	65	27.4	175	32.5
5	8	52	17	30	12.6	82	15.2
8	10	8	2.6	5	2.1	13	2.4
10	15	6	1.9	5	2.1	11	2
	>15	1	0.3	1	0.4	2	0.4

Table 1 - Classification of schools by height.

Width (m)		1982-1983		1983-1984		Total	
From	Up to	Quantity	%	Quantity	%	Quantity	%
0	5	69	22.8	22	9.3	91	16.9
5	10	93	30.1	65	27.4	168	31.2
10	15	59	19.5	68	28.7	127	23.6
15	20	22	7.3	36	15.2	58	10.7
20	30	39	12.9	26	11	65	12.1
30	40	9	2.98	20	8.4	29	5.4
40	50	9	2.98	-	-	9	1.6
50	100	2	0.6	-	-	2	0.4

Table 2 - Classification of schools by width.

Volume (m ³)							
From	Up to	Quantity	%	Quantity	%	Quantity	%
0	100	118	39.1	49	20.6	167	31
100	500	101	33.4	104	43.8	205	38
500	1000	35	11.6	34	14.3	69	12.8
1000	2000	26	8.6	17	7.1	43	8
2000	5000	11	3.6	17	7.1	28	5.2
5000	10000	10	3.3	7	2.9	17	3.2
	>10000	1	0.3	9	3.8	10	1.8

Table 3 - Classification of schools by volume.

Distance		1982-1983	
From	Up to	Number	%
0	5	59	19.5
5	10	98	32.5
10	15	89	29.5
15	20	31	10.3
20	25	19	6.3
25	30	3	1
	>30	3	1

Table 4 - Distance of the school's centre of gravity from the sea-bottom.

The schools widths measured up to 30 m and were grouped into five classes (0-5; 5-10; 10-15; 15-20; 20-30 m. We can say that sardine schools have a characteristic slight horizontal extension (the most probable extension being up to 30 m.). Considering the volume of the schools as their most important geometrical parameter, we can say that there are two predominating classes:

- Up to 100 m³: 118 schools (39.1 per cent) and 49 schools (20.6 per cent) respectively, or for the two years taken together a total of 167 schools (31 per cent).
- From 100 m³ to 500 m³: 101 schools (33.4 per cent) and 104 schools (43.8 per cent) respectively, or a total of 205 schools (38 per cent).

The schools with a volume greater than 2000 m³ are rare in this period of the year.

A parameter of importance to the pair fishing is also the distance between schools and sea-bottom. As can be seen from Table 4, schools with their centre of gravity of 5 - 10 m (32 per cent) and 10 to 15 m (29.5 per cent) above sea-bottom predominate.

Conclusions

In their spawning season sardines swim in schools during the day, when trawl pair fishing is carried out.

The richest zone lies at a depth of 30-100 m, parallel to the coast.

The height of schools goes as far up as 20 m, with a marked prevalence of up to 8 m.

Sardine schools have a characteristic width up to 30 m, while the schools of a width of 100 m or more are rarely encountered.

Schools of a volume of up to 500 m³ make up 69 per cent of the total number of schools and they swim near the sea-bottom where fishing with pair trawls is carried out. Hence, the bulk of fishing is done at this level.

From biological analyses carried out during the periods under discussion, it results that sardine schools are made up of sardines older than two years.

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ANNEX (E) W

Juvenile sardine along the eastern Adriatic coast
- studies and protection -

by

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Juvenile sardine (Sardina pilchardus Walb.) started to occur in mass and to be fished along the eastern Adriatic coast at the beginning of May 1983. Mass occurrence of young juvenile sardine was recorded from the area of Istra (eastern part), Gulf of Rijeka, Velebit Channel and particularly from the bays Novigrad Bay and Karinsko Bay. No juvenile sardine were recorded south from the Kaštela Bay. In fact the catches from 1981 were already indicative of a sardine mass occurrence but it was taken to be a kind of normal occurrence of a greater quantities of these fish after a series of years.

Occurrences of juvenile sardine in the close vicinity of the coast were recorded earlier, as well (Mužinić, D., 1936; Ercegović, 1940 and J. Karlovac, 1967). In their metamorphosis and juvenile stages sardine stay close to the land where hydrological conditions vary considerably primarily due to small depths, vicinity of the coast and land freshwater discharges (Kačić, 1972). Sardine begin to concentrate and school in their juvenile stage at what time they are also first recruited.

The exact time of the occurrence of juvenile sardine varies from one year to another. Thus they occurred as early as in February in 1981, from June to September in 1983 and from April on in 1984.

The length distribution was also different (Fig.1). For juvenile sardine sampled in February 1981 length ranged from 75 to 115 mm, the mean length was 89.52 mm. In 1983 samples, individuals which ranged between 51 and 90 mm had the mean length of 67.6 mm in June and attained 74.4 mm in August. Juveniles sampled at the beginning of April 1984 had 82.8 mm mean length and they attained 92.3 mm mean length at the end of that month.

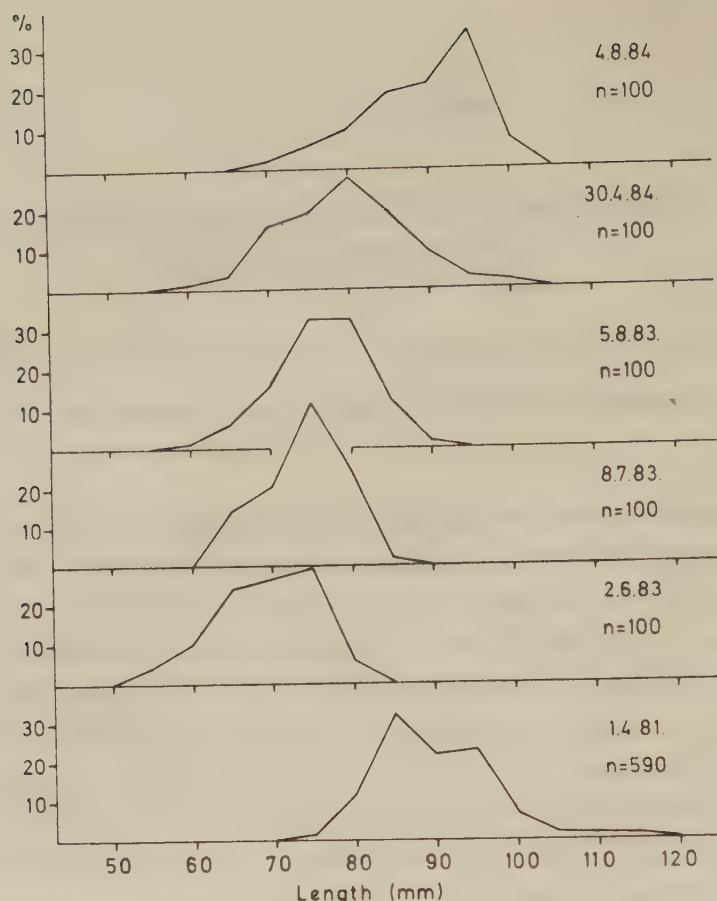


Fig. 1 - Length distribution of juvenile sardine in the eastern Adriatic Sea.

According to the report of fishermen in 1983 juvenile sardine occurred in such a quantity that have never been recorded before. They could be easily caught from the land. In the beginning sardine occurred together with sprat but during the summer only sardine remained. The following preliminary data can illustrate the quantities in which these fish were landed only to a certain extent:

May	Jun	Jul	Aug	Sept	Oct
14 t	30 t	20 t	10 t	10 t	15 t

According to the personal communications of fishermen from Novigrad, where from juvenile sardine were mostly captured about 500 t of juvenile sardine were caught from the Novigrad Bay that year.

In Marine Fisheries Law and the Regulation of the protection of fish fry, juvenile fish and other marine animals, the term adolescent fish means: not sufficiently developed fish the length of which does not exceed 10 cm for sardine (*Sardina pilchardus* Walb.), 7 cm for sprat (*Sprattus sprattus*) and 10 cm for anchovy (*Engraulis encrasicolus*).

All the analysed catch samples showed the fish of length smaller than that permitted by the Law.

From the results of studies of the ecology of sardine and their relatives it appears that, as a rule, adult sardine migrate from the coastal area offshore or towards the deep Adriatic parts because of spawning, hibernation, food (predominantly). Early in spring, larval stages and juvenile fish return to the coastal part of the Adriatic and the smallest individuals enter the bays (Novigrad Bay, Karinski Bay, Šibenik Bay, Kaštela Bay, Mošćenička draga, Boka Kotorska etc.).

This situation raises a number of very important questions to be solved. Firstly, to what quantity amounts the total stock of this juvenile fish in the areas wherefrom they are recorded. Secondly, for how long to they keep in these areas and, thirdly, whether they hibernate there or not. This last question is of particular interest to be answered to since according to fishermen this juvenile fish keep in that area all year long. This would mean that this part of the sardine stock is its "lost part" from which no adult sardine stock is formed in the Adriatic since they do not migrate offshore in autumn (where temperature and salinity conditions are stable) and that they in fact spawn in these areas.

On the other hand, if these fish migrate offshore towards the spawning areas, and we rather believe they do, then the problem of their protection in the stage of their most intensive growth is a very serious one, since just these fish later become (under normal conditions) the bulk of the Adriatic sardine stock.

It is therefore expected that this large stock of juvenile fish recorded in 1983 will be reflected upon the significantly increased catches during this and next fishing season since it is assumed that, in spite of intensified fishing, only a smaller part of it has been caught.

As agreed upon by the respective authorities of the Republic of Croatia and with the fishermen engaged mainly in fishing for juvenile sardine, an amendment regulation governing the protection of fish fry and juvenile fish was laid down in August 1985 to be in force until December 31, 1987. By this regulation the catch of juvenile sardine, sprat and anchovy is exceptionally permitted in the bays Novigrad and Karinsko so as to allow studies of the occurrences of juvenile fish in these areas by the Institute in Split.

The goals of the study of juvenile sardine population may be described as follows:

- to establish their presence and distribution,
- to assess their stock,
- to establish the cause-and-effect of the phenomenon and their distribution,
- to propose the way of their control (optimum catch) and rational exploitation.

Studies will cover the period of two years. It is expected to come to the results which will allow the proposals to be made concerning the control and rational exploitation of juvenile fish along the eastern Adriatic coast.

ANNEX (E) X

Statistical analysis of the anchovy stock estimates
from data obtained by egg surveys

by

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INTRODUCTION

Anchovy, Engraulis encrasicolus (Linnaeus, 1758), belongs to the small pelagic fishes which are of relatively great economical importance in the Adriatic. The mean catch of this fish was, during the period from the year 1972 through 1982, 36 118 tons. Italian catch was 33 858, and Yugoslav 2 226 tons (GFCM Stat. Bull., 5, 1984). According to these landings, anchovy takes the second place among the pelagic fishes in the Adriatic, behind the sardine. Due to this fact, several attempts were done up to now to estimate biomass of this fish.

It is relatively strange that most of the past estimates were done by direct methods, either by echosurveys (A z z a l i, 1980; A z z a l i et al., 1983; K a ĉ i ć, 1983), or by egg surveys (Š t i r n, 1969; K a r l o v a c et al., 1974; P i c c i n e t t i et al., 1979; P i c c i n e t t i et al., 1981). The estimates obtained by other methods are scarce (G r u b i š i ć et al., 1974; L e v i et al., 1983).

As far as the estimates obtained by egg surveys are concerned, it has to be mentioned that the corrections for the mortality of the eggs were not used up to now.

The aim of this paper was to present the results of the anchovy biomass estimates, using the procedure which includes all the elements needed for such appraisals, and to estimate the limits of confidence using almost the same way of statistical analysis as it was made for the former estimates of sardine biomass (R e g n e r et al., 198 and 1983).

MATERIAL AND METHODS

The plankton was sampled by double-oblique hauls of Bongo-20 plankton net equipped with the flow- and depthmeters. The mesh size at one cylinder was 236 µm, and 335 µm at the other. The anchovy eggs from each net were sorted separately, and the mean number from both cylinders was calculated for every haul. The net was towed 10-20 minutes at a speed of

1.5-2 knots. The maximal depth of hauls was approximately 60 m. The surveys covered the area from the Gulf of Trieste to the line which connects Monte Gargano and Boka Kotorska. There were ten profiles over this area, which were placed transversally from the Italian coast to the edge of Yugoslav territorial waters (Fig.1).



Fig. 1 - Distribution of profiles and stations, example from July, 1982.

The egg surveys for the anchovy biomass estimation were performed during the period of 9 years, from 1976 to 1984. Only for the spawning season in the year 1976 two cruises were made, while for all the other seasons only one cruise/season was done, so that there were ten cruises in total. Only the second cruise in 1976, and the cruise in 1977 were performed in September. Surveys in all other years were done in the period July-August. The number of stations per cruise varied from 58 to 68. The 638 ichthyoplankton samples were taken in total. Neither profiles nor stations were not at the same positions for every cruise, but they covered allways the same areas.

At every station the temperature of the sea water from 1 m depth was recorded. These data were used for estimations of the duration of the egg stage from spawning to hatching. During the sorting, all anchovy eggs were divided

in four previously defined embryonic stages. Together with the temperature dependent duration of embryonic development, these data were used for the estimations of the instantaneous mortality coefficients of the eggs. The method used for these estimations was formerly described (R e g n e r, 1979).

As there were no more than one cruise per spawning season, with the afore mentioned exception of the year 1976, the intensity of spawning during the entire spawning seasons was monitored at 1-3 fixed stations in vicinity of Fano, Trieste and Split. The least frequency of sampling at these stations was once a month. The curves of spawning intensity obtained from these stations were used for estimations of the total number of eggs produced during the spawning season.

The stock size was estimated from the expression:

$$B = \frac{E}{F_r} (1 + R) \quad (1),$$

where B is the estimated biomass of spawners, E is the estimated total number of eggs produced during the spawning season over the surveyed area, F_r is the relative fecundity, and R is the sex ratio.

As such estimates are to be used for the management purposes and for the studies of population dynamics, it is most important to estimate their limits of confidence. From equation (1) it can be seen that the variance of B has three main components, which are particular variances of E, F_r , and R. As, in general, only one cruise was undertaken during the spawning seasons, the fourth important component of variability is the shape of the curves of spawning intensity.

Althouhg it is known that relatively high variability exists between the ratio of males and females of the anchovy, their ratio in general is equal to 1 (V a r a g n o l o, 1967; S i n o v ě i ć, 1978; P i c c i n e t t i et al., 1979). So, in this paper it was assumed that value of R has not important variability, and that:

$$(1 + R) = 2$$

The estimates of the total anchovy egg production can be derived from the estimated egg production under the unit of surface per unit of time for every plankton haul taken during the surveys.

The abundance of eggs under the unit of surface (1 m^2) was calculated from the equation:

$$Y = \frac{X}{S \cdot f \cdot \frac{D}{d}} \quad (2), \text{ T a n a k a (1973),}$$

where Y is the number of eggs under 1 m^2 , X is the number of eggs in the sample, f is filtration efficiency (which was assumed to be ~ 1), D is the distance towed, and d is the maximal depth sampled.

The estimate of anchovy egg production under $1 \text{ m}^2/\text{day}$ was calculated from the expression:

$$N = \frac{Y}{\frac{1}{m} (1 - e^{-mD})} \quad (3),$$

where N is an estimated number of eggs produced under $1 \text{ m}^2/\text{day}$, Y is the number of eggs under 1 m^2 from equation (2), m is the instantaneous mortality rate, and D is the time in days from spawning to hatching of the eggs.

The time of spawning to hatching, as a function of temperature, was calculated from the equation whose parameters have been obtained from observations on temperature-time relationship of embrionic development of anchovy eggs in experimental conditions (R e g n e r, 1979):

$$D = \frac{1}{1.012896} (1 + e^{4.914322 - 0.257451 T}) \quad (4),$$

where D is the incubation time in days, and T is the temperature in $^{\circ}\text{C}$. The correlation coefficient is:

$$r = 0.9999; P < 0.001$$

The total variance of N could be decomposed on particular variances of Y, m and D values. Values of m and D have three components of variability. The first one is a short-time scale component of estimation of m for D period of days and of estimation of D as a function of temperature. The second is the long-time scale variability of m and D during the spawning season, while the third one is the spatial variability of m and D over the surveyed area. In this paper only the short-time scales of variability of m and spatial variability of D have been statistically analysed.

The estimation of the total quantity of eggs spawned per day per every single cruise can be computed from the equation:

$$E_C = P \frac{1}{n} \sum_{i=1}^n N_i \quad (5),$$

where P is the surface of the area surveyed, n is the number of stations, and N_i is the number of eggs/ m^2 /day estimated for the i -th station.

To estimate total number of eggs produced during the spawning season, E_c has to be integrated over the curve of spawning intensity. This method implies the large possibility of error (Regner *et al.*, 1983) and it needs a very careful statistical analysis of spawning intensity curves.

RESULTS AND DISCUSSION

(a) Post Stratification of the area

The comparison of the total means of Y and their variances for every cruise showed that the variances were relatively strongly dependent on the means (Fig.2). This indicates that the distribution of anchovy eggs/ m^2 is non-random, but probably a contagious one, and that for further statistical analysis the surveyed area must be poststratified.

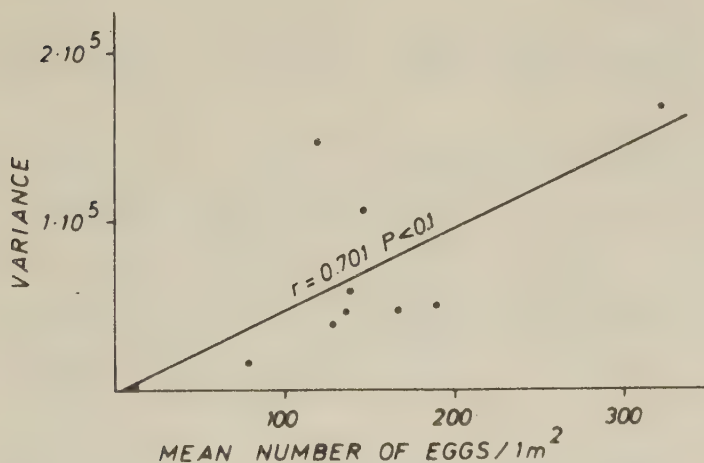


Fig. 2 - Relationship between mean number of eggs/ m^2 and corresponding variances.

The poststratification was made in the following way. The total area surveyed was divided in 49 squares, as it is shown in Fig. 3. The sides of squares were 30' of longitude and latitude. After that the mean numbers of eggs/ $1 m^2$ /day were calculated for every ten cruises and for every square. The next step was the analysis of variance for unequal sample sizes (Sokal and Rohlf, 1969).

The results of this analysis are shown in Table 1.

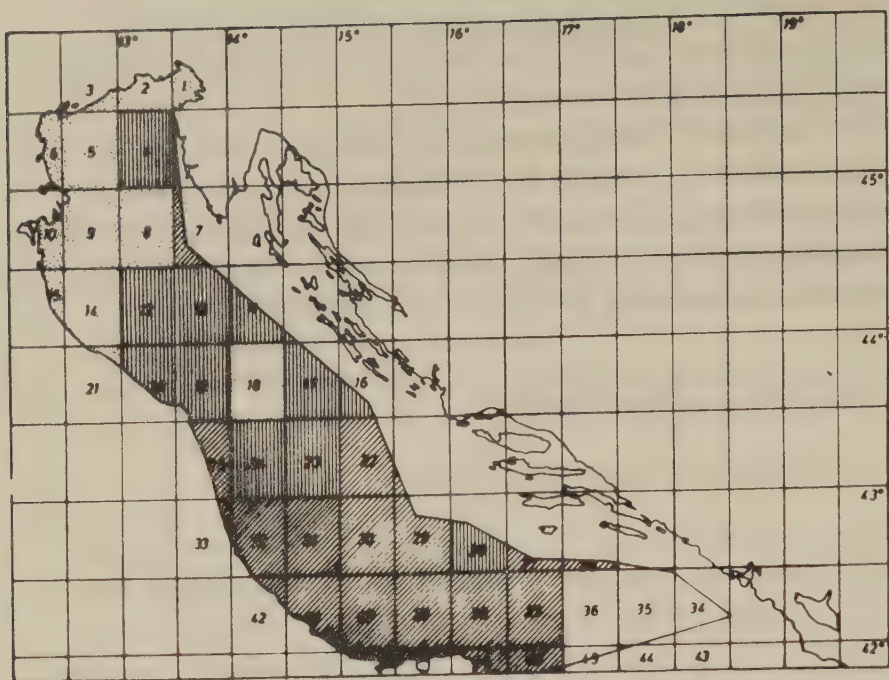


Fig. 3 - Squares ranked by SNK test.

Table 1. Analysis of variance of N distributed over the squares.

Source of variation	df	SS	MS	FS
N - $\bar{N}$ (among squares)	42	24 537 852	584 234.57	5.838*
N - $\bar{N}$ (within squares)	595	63 745 267	100 071.06	P < 0.001
N - $\bar{N}$ (total sample)	637	88 283 119		

$$*F_{0.001}(42, 595) = 1.845$$

As it can be seen from Table 1., the component of variance among the squares is significantly higher than the component of variance within the squares. From the biological point of view, that means that the anchovies in the Adriatic have clearly distinctive centers of spawning, which is, in this case confirmed by relatively long (nine years) time series of data.

Basing on the analysis of variance, poststrata were designed by using of SNK test of the least significant range for the significance level of 95% (Sokal and Rohlf, 1969). This test showed the following similarity of the squares:

Category	Squares N ^o	$\bar{N}$
I	1, 2, 3, 5, 6, 8, 9, 10, 14, 15, 18, 21	472.38
II	4, 11, 12, 13, 16, 17, 19, 20, 23, 24, 28	246.28
III	7, 22, 25, 26, 29, 30, 31, 32, 37, 38, 39 40, 41, 42, 46, 47	165.85
IV	34, 35, 36, 49	0.0



Fig. 4 - Defined poststrata.

The isolines of poststrata were constructed to connect the squares of the same range, where it was possible. In that way total surveyed area was divided in seven poststrata (Fig. 4). The surfaces of poststrata are as follows:

Poststratum	Surface (km ²)
I	12 235.7
II	1 962.2
III	20 082.5
IV	905.3
V	23 932.2
VI	1 525.0
VII	6 378.0
Total area surveyed	67 020.9

These poststrata were used for calculation of variances for all ten cruises.

Besides the variance of $\bar{Y}$ (equation 7), if the correction terms for m and D were used, their component of variance should be calculated too. This was done in the following way. It can be assumed that the denominator form equation (3) is equal to:

$$\frac{1}{m}(1 - e^{-mD}) = Z$$

The variance of Z can be estimated from the expression:

$$S_z^2 = \left(\frac{1}{m} e^{-mD}\right)^2 \left\{ \left(\frac{1}{m}\right)^2 S_m^2 + \left(\frac{1}{D}\right)^2 S_D^2 + \left(\frac{2\delta m \delta D}{m D}\right) \right\} \quad (10).$$

Accordingly, total variance of the cruise will be:

$$S_c^2 = \frac{\bar{Y}_{tot}}{Z_{tot}} \left(\frac{S_y^2}{\bar{Y}_{tot}^2} + \frac{S_z^2}{Z_{tot}^2} \right) \quad (11),$$

where values of S_z^2 are obtained from equation (10), for every cruise separately.

The confidence limits of $\bar{N}_c$ were estimated in the way that standard errors (S_c) were calculated, and after that the confidence limits have been estimated using the t-test procedure. The results obtained are shown in Table 3.

Table 3. The mean numbers of eggs spawned under 1 m²/day during the cruises, their variances and 95% confidence limits.

Cruise	$\bar{N}_c$	S_c^2	$\bar{N}_c + t_{.05} S_N$	$\bar{N}_c - t_{.05} S_N$
1976	158.5	23 936.6	197.5	119.5
1976a	17.0	269.5	21.0	13.0
1977	122.0	4 251.5	142.6	101.4
1978	398.7	94 799.8	475.6	321.8
1979	178.7	17 483.3	211.6	145.8
1980	228.5	31 750.9	272.2	184.8
1981	126.7	129 477.6	216.2	37.2
1982	215.5	41 969.9	266.9	164.1
1983	127.9	93 012.6	203.2	52.6
1984	139.1	17 671.2	172.2	106.0

From these data, using equation (9), the total numbers of eggs spawned over the entire surveyed area per day as well as their confidence limits were estimated for every cruise (Tab.4).

Table 4. Estimated numbers of eggs spawned per day over the surveyed area, and their 95% confidence limits.

Cruise	E_c	$E_c + .05$	$E_c - .05$
1976	$1.062 \cdot 10^{13}$	$1.324 \cdot 10^{13}$	$8.009 \cdot 10^{12}$
1976a	$1.139 \cdot 10^{12}$	$1.407 \cdot 10^{12}$	$8.713 \cdot 10^{11}$
1977	$8.177 \cdot 10^{12}$	$9.557 \cdot 10^{12}$	$6.796 \cdot 10^{12}$
1978	$2.672 \cdot 10^{13}$	$3.188 \cdot 10^{13}$	$2.157 \cdot 10^{13}$
1979	$1.198 \cdot 10^{13}$	$1.418 \cdot 10^{13}$	$9.772 \cdot 10^{12}$
1980	$1.531 \cdot 10^{13}$	$1.824 \cdot 10^{13}$	$1.239 \cdot 10^{13}$
1981	$8.492 \cdot 10^{12}$	$1.449 \cdot 10^{13}$	$2.493 \cdot 10^{12}$
1982	$1.444 \cdot 10^{13}$	$1.789 \cdot 10^{13}$	$1.100 \cdot 10^{13}$
1983	$8.572 \cdot 10^{12}$	$1.362 \cdot 10^{13}$	$3.525 \cdot 10^{13}$
1984	$9.323 \cdot 10^{12}$	$1.154 \cdot 10^{13}$	$7.104 \cdot 10^{12}$

The limits of confidence for 95 % significance level of the mean E_c are + 27.25% and - 27.22%.

(c) Changes of spawning intensity during the spawning seasons and estimates of total number of eggs produced per spawning season

From the fixed stations in the vicinity of Fano, Split and Trieste there were obtained 33 curves of the intensity of spawning of anchovy during the nine years of surveys. In all these years anchovy spawned from April to October.

The analysis of spawning curves showed that they were very irregular, with the maxima of the egg production being dispersed from June to September without any correlation with areas of the fixed stations. This indicates the well known fact that the anchovies displace their centers of spawning over the spawning area during the spawning season (Varagnolo, 1965; Štirn, 1969). In this case that means that the centers of spawning are moving within and/or among the poststrata during the spawning season. Although there are another causes of the changing intensity of spawning during the season, such as changes in age structure or the variability of ecological factors (temperature, quantity of food etc.), in this case the displacement seems to be the most important factor.

From that reason it was decided to use one general spawning curve for integration of E_c from all the cruises. For that purpose, there were calculated mean values of eggs spawned under $1 \text{ m}^2/\text{day}$ for every month from April to October, as well as the corresponding standard errors of the

means (S). Using the t-test procedure that upper and lower limits of confidence, in this case for the 95% significance level, are:

$$\bar{N} \pm t_{.05} S_{\bar{N}},$$

there were obtained extreme shapes of the mean curve, as it is shown in Fig. 5.

It can be seen that in general the mean curve approaches to normal distribution with the maximum production of the eggs centered in the median month of spawning season - in July. The extreme shape for the limits of confidence for $\bar{N} - t_{.05} S_{\bar{N}}$ (Fig. 5, c) shows the maximum of egg production in June with the relative maximum in August-September.

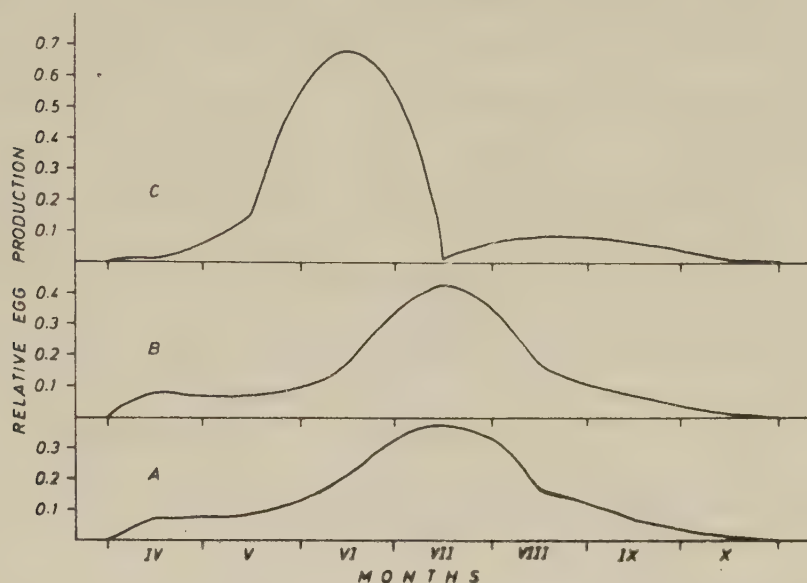


Fig. 5 - The general curve of spawning intensity of the anchovy;
 A = mean, B = upper 95% confidence limit, C = lower 95% confidence limit.

To obtain total numbers of eggs produced during every spawning season (E), the method of planimetry was used. The surface obtained by measuring the area under the spawning curve which was covered by cruise was divided by the surface under the entire curve:

$$\frac{S}{S} = r$$

The extreme values of E were estimated in the following way:

$$E_{+.05} = \frac{E_{C+.05}}{r_{-.05}}, \quad \text{and}$$

$$E_{-.05} = \frac{E_{C-.05}}{r_{+.05}}$$

The results obtained are shown in Table 5.

Table 5. Estimated total numbers of eggs produced during the spawning seasons and their confidence limits

Year	E	$E_{+.05}$	$E_{-.05}$
1976	$9.264 \cdot 10^{14}$	$1.129 \cdot 10^{16}$	$6.492 \cdot 10^{14}$
1976a	$4.972 \cdot 10^{14}$	$9.985 \cdot 10^{14}$	$5.018 \cdot 10^{14}$
1977	$3.687 \cdot 10^{15}$	$5.275 \cdot 10^{15}$	$2.448 \cdot 10^{15}$
1978	$2.648 \cdot 10^{15}$	$2.057 \cdot 10^{16}$	$2.074 \cdot 10^{15}$
1979	$1.207 \cdot 10^{15}$	$8.992 \cdot 10^{15}$	$9.595 \cdot 10^{14}$
1980	$1.620 \cdot 10^{15}$	$1.019 \cdot 10^{16}$	$1.266 \cdot 10^{15}$
1981	$8.211 \cdot 10^{14}$	$9.896 \cdot 10^{15}$	$2.215 \cdot 10^{14}$
1982	$1.260 \cdot 10^{15}$	$1.526 \cdot 10^{16}$	$9.365 \cdot 10^{14}$
1983	$8.877 \cdot 10^{14}$	$8.447 \cdot 10^{15}$	$3.437 \cdot 10^{14}$
1984	$9.036 \cdot 10^{14}$	$1.207 \cdot 10^{15}$	$6.187 \cdot 10^{14}$

The lower confidence limit amounts -30.71%, while the upper one amounts even +537.14% of the mean E. This shows how large error can arise if the spawning curves are used for estimates of the total production of the eggs. Practically, there is no way to estimate reliable confidence limits for the integration of E_c values over the spawning curves. That means that in future investigations the strategy of surveys must be changed. The most convenient, and the most precise way will be to reduce the numbers of stations per cruise by weighting them by variances of the particular strata, and to make more cruises, at least three, during the spawning season.

(d) The fecundity of the anchovy and the estimates of biomass

During the period of surveys, with the exception of the year 1976, there were no simultaneous investigations of the fecundity of the anchovy. So, for the estimates of biomass the data on relative fecundity obtained during the investigations in the year 1976 were used (Picinetti et al., 1979). According to these data, the relative fecundity, i.e. the number of oocytes per gram of female, is:

$$F_r = 1\ 299$$

The relative fecundity of the anchovy seems to be relatively stabile, because the results obtained in 1976

are practically akin to those of V a r a g n o l o (1967), which have been obtained ten years before. This indicates that the relative fecundity, as a relative stable factor, can not cause large errors of biomass estimates from statistical point of view. But, there is a problem which is not biologically clear enough. Namely, anchovies are serial spawners, and in the ovaries there were always found three to four batches of oocytes of different sizes, which in total gave the value of F_r of 1 299 eggs per gram of female. It can be supposed that the number of batches might be greater than four. This is very probable, because in the case of northern anchovy (Engraulis mordax Girard) it was found that females spawned every 6-8 days during the peak of spawning season (H u n t e r and G o l d b e r g, 1980). If the anchovy in Adriatic spawns in the similar way, the error of biomass estimate can be large. Because of that the future very carefull analyses of anchovy's fecundity are indispensable, but for this moment it was assumed that obtained value of F_r has been reliable.

The biomass was estimated by substituting of values of E and F_r in the equation (1), while the confidence limits were estimated by use of $E^{\pm 0.05}$ values from Table 5.

The results obtained are as follows:

Year	Biomass (tons)	Upper limit	Lower limit
1976 (mean)	1 095 919	9 459 969	886 046
1977	5 676 674	8 121 632	3 769 053
1978	4 076 982	31 670 516	3 193 225
1979	1 858 352	13 736 721	1 477 290
1980	2 494 226	15 688 992	1 948 549
1981	1 264 203	15 236 336	341 031
1982	1 939 954	23 494 996	1 441 878
1983	1 366 743	13 005 389	529 176
1984	1 391 224	1 858 353	952 578

The limits of confidence are, like the limits of E , - 31% and + 526% of the mean biomass estimated for the entire period of nine years. The reliability of estimates is strongly influenced by the variability of the spawning curves.

The results of estimates for the years 1976-1979 are different from those obtained for the same years, and from the same surveys (P i c c i n e t t i et al., 1979 and 1981). The source of differences is that in the previous estimates neither corrections for the mortality of the eggs, nor weighting of the egg distribution by poststrata were not used.

The estimates show that, from the year 1979 on, there is substantial decrease of the anchovy biomass in the Adriatic with the coefficient of the trend $b = - 276\,949 \cdot 3$ ($r = -0.491$; $P < 0.2$). This is probably not caused by overfishing because there is negative, although insignificant, correlation ($r = -0.397$, n.s.) between the Italian and Yugoslav annual catch of the anchovy and the estimates of its biomass. This relationship can be seen also from figure 6. Moreover, if even lower limits of confidence of estimates are compared with the data of annual catches (GFCM Stat. Bull., 5, 1984), it seems that the anchovy in the Adriatic is fairly underexploited.

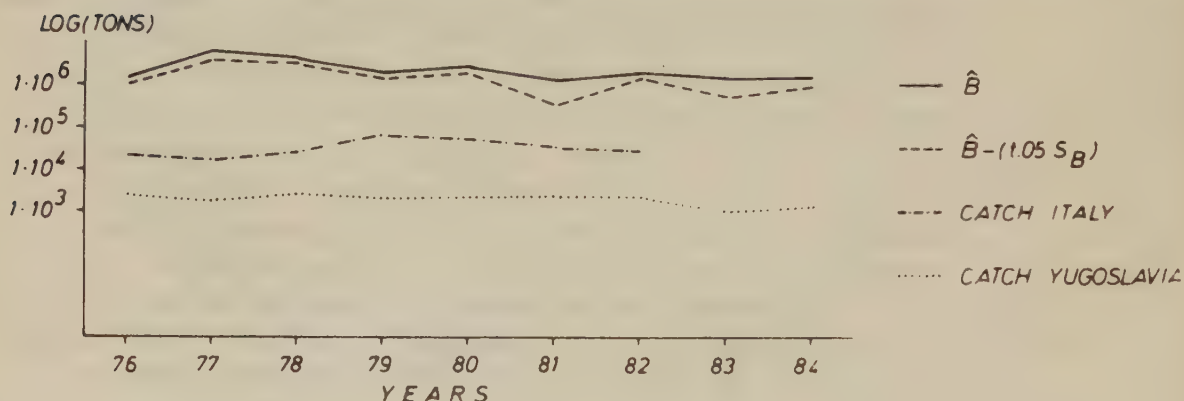


Fig. 6 - The relationship between the estimated biomass and the catch of the anchovy in the Adriatic.

CONCLUSIONS

The estimates of the biomass of the anchovy for the period from the year 1976 to 1984 were made. The decrease of biomass from the year 1979 on has been observed. It seems that this decrease did not affect the catch of the anchovy in the Adriatic, moreover negative correlation between the biomass and annual catches has been found.

The statistical analysis showed that the reliability of estimates were mostly affected by the irregularity of the curves of the intensity of spawning during the spawning season. In the future surveys this problem should be avoided by making more than one cruise during the spawning season. The number of cruises should be three at least, and they have to be made at the beginning, peak, and at the end of spawning season.

The further studies of fecundity are also needed, because there is a considerable probability that the mean number of spawnings per female during the spawning season is underestimated.

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ANNEX (E) Y

Réflexions pour un aménagement de la zone côtière des 12 milles
par des fermetures saisonnières de la pêche

par

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La pêche dans la zone côtière présente un intérêt particulier sur le plan biologique et social en Italie. Cette zone est celle où les effets de toutes les activités humaines, pollution, tourisme, pêche sont les plus intenses et en même temps celle où se déroulent les phases plus délicates des cycles biologiques de plusieurs organismes marins.

En Italie les zones côtières se présentent avec une morphologie différente. En général les fonds sont plats et constitués de sable ou de vase. Les fonds rocheux et à forte pente existent seulement dans le sud de l'Adriatique; la profondeur à 12 milles de la côte varie de 40 m. dans l'Adriatique nord à environ 1000 m. dans le sud. Ces différences se reflètent sur les espèces présentes, les cycles biologiques, les techniques de pêches utilisées et l'intensité de la pêche.

Parmi les différents organismes marins d'intérêt économique, il y en a plusieurs qui ont tout leur cycle vital dans la zone côtière, d'autres qui se déplacent plus ou moins régulièrement de la côte vers le large et d'autres qui en général restent en dehors de la zone côtière.

Dans la situation italienne, les deux premières catégories ont la plus grande importance sur le plan des quantités, de la valeur et du nombre des pêcheurs intéressés.

Dans la zone côtière on pêche la plupart des bivalves (plus de 150.000 tonnes de production annuelle en Adriatique): Venus gallina, Mytilus galloprovincialis, Tapes spp., Ostrea edulis, Donax spp., Crassostrea spp.

Dans la zone côtière, en mer ouverte et dans les lagunes, existent des formes de mariculture pour mollusques, crustacés et poissons, en particulier Anguilla anguilla, Sparus aurata, Dicentrarchus labrax, Mugil spp. espèces qui vivent à l'état naturel dans cette zone côtière. D'autres espèces vivent presque exclusivement dans la zone des 12 milles, telle que Squilla mantis, Octopus vulgaris, plusieurs espèces du genre Gobius, Atherina, Pleuronectes flesus, Solea lutea, etc.

Le groupe des espèces qui si déplacement de la zone côtière vers le large comprend Sepia officinalis, Loligo vulgaris, Alloteuthis media, Mullus barbatus et M. surmuletus, Solea vulgaris, Arnoglossus laterna, Lithognatus mormyrus, Trigla gurnardus, Pagellus erythrinus, Gadus merlangus et quelques poissons pélagiques Sardina pilcardus, Engraulis encrasicolus, Trachurus sp. Dans les zones côtières à profondeur élevée on trouve plusieurs autres espèces, Eledone moschata et E. cirrhosa, Nephrops norvegicus, quelques sélaciens, Merluccius, Trisopterus minutus capelanus, des triglidés, des sparidés, etc.

Si l'on considère la production totale de la pêche italienne en Adriatique, on observe que la plus grande partie en est capturée dans une zone côtière de 12 milles. Cette situation de production reflète la distribution de l'effort de pêche.

En sud Adriatique la totalité de la pêche se déroule à l'intérieur de la zone des 12 milles, excepté pour la pêche aux grands pélagiques. Dans la haute et moyenne Adriatique où existent des zones chalutables au large, il y a un certain nombre de bateaux qui pêchent en dehors de la zone des 12 milles.

Cette situation est plus évidente en considérant la répartition par taille de la flottille de pêche; le nombre de bateaux de pêche à moteur était en décembre 1981 dans la sous-zone 37.4, de 5.428 avec un tonnage total de 84.169 TJB. 371 bateaux seulement ont un tonnage supérieur à 50 TJB et une partie de ces bateaux pêche toute l'année ou une partie de l'année dans la zone côtière. Dans la zone côtière opèrent également des bateaux professionnels à voile ou à rames et toute la pêche de plaisance. On peut dire que dans la zone côtière on a un effort de pêche très varié mais toujours très intense.

Les lois italiennes prévoient un certain nombre de réglementations pour la pêche dans la zone côtière, qui diffèrent d'un engin de pêche à l'autre mais qui incluent la fixation de la taille minimale des poissons, du maillage légal pour chaque type d'engin de pêche, des zones d'interdiction etc.

Les mesures existantes ne sont pas toujours très respectées, à cause de difficultés de surveillance et de la concurrence entre les pêcheurs pour capturer plus de poisson. Il est nécessaire d'envisager une forme de réglementation plus facile à faire respecter.

La plupart des espèces capturées ont un cycle vital très rapide avec la ponte à l'âge de 1 ou 2 ans et le recrutement influence grandement les captures; il semble pourtant possible d'obtenir des résultats importants pour l'accroissement des captures, en instituant des zones et/ou des périodes de fermetures de la pêche.

Sur le plan de la production, on peut obtenir de bons résultats si on ferme la pêche dans les zones et/ou dans la période où commence traditionnellement la pêche des jeunes recrues, de façon à avoir 1 ou 2 mois après, des recrues de plus grande taille.

Les problèmes qui se posent pour mettre en oeuvre une telle réglementation sont complexes. L'interdiction de pêcher dans une zone donnée pose des problèmes de contrôle plus difficiles à résoudre que dans le cas d'une interdiction de la pêche pendant une saison.

Sur le plan du commerce, si dans un secteur on ferme complètement toute forme de pêche, on augmente l'importation des produits provenant d'autres zones, souvent avec des variations de prix et des modifications des circuits commerciaux.

Si l'on ferme la pêche seulement pour une catégorie de pêcheurs, il faut s'assurer que les autres pêcheurs n'en profitent pas pour pêcher les espèces protégées.

De toutes façons il faut prévoir, pour des raisons sociales, une rémunération pour les pêcheurs à quai, au moins jusqu'à ce qu'ils aient constaté qu'après la période d'arrêt de la pêche l'augmentation des captures (qui entraîne des variations des prix) peut compenser la période d'inactivité.

La biologie varie d'une espèce à l'autre; l'interdiction de pêche dans une période et/ou dans une zone ne peut pas conduire à des bénéfices pour toutes les espèces et pourra avoir des conséquences différentes d'un secteur à l'autre. Il semble que dans la situation actuelle de la pêche en Adriatique une fermeture d'un ou de plusieurs types de pêche, dans des zones définies pendant une période limitée, devrait être expérimentée dans une ou deux zones. Sur la base des résultats obtenus, on pourrait évaluer la possibilité d'étendre à d'autres zones une telle mesure. Les bénéfices d'une période d'interdiction de pêche devraient être dans certains cas presque immédiats à cause de la rapidité des cycles vitaux.

En haute Adriatique une réglementation expérimentale pourrait consister dans l'interdiction de la pêche au chalut dans la zone entre 0 et 6 milles du 15 août jusqu'au 30 septembre. Tous les chalutiers inférieurs à 10 TJB devraient rester à quai et être indemnisés pour la période d'arrêt; quelques petits chalutiers avec leurs pêcheurs, mais sans filets, pourraient être utilisés pour surveiller que les chalutiers plus grands et les bateaux avec chalut pélagique restent en dehors de la zone. La pêche avec engins sélectifs à l'intérieur de la zone (filets maillants, nasses, hameçons, dragues à coquilles, etc.) pourrait continuer comme la pêche au

chalut en-dehors de la zone des 6 milles de façon à continuer à approvisionner le marché.

Pendant la période suivante, du 1er octobre au 15 novembre, les chalutiers de plus de 10 TJB devraient rester à quai ou pratiquer la pêche en-dehors des 12 milles et la zone de protection devrait être entre 6 et 12 milles; quelques grands chalutiers pourraient être engagés pour la surveillance. Durant cette période les petits chalutiers inférieurs à 10 TJB pourraient opérer dans la zone côtière à l'intérieur des 6 milles. Les captures plus élevées obtenues après la première période d'arrêt devraient trouver des débouchées plus libres à cause du manque de production des grands chalutiers. Les espèces plus importantes pour déterminer les bénéfices seront Sepia officinalis, Loligo vulgaris, Alloteuthis media, Mullus barbatus, Lithognatus mormyrus, Solea lutea et les gobiidés.

Une réglementation pour les ressources pélagiques ne semble pas nécessaire car les stocks demeurent élevés, et une réglementation pour les espèces qui vivent presque exclusivement en-dehors de la zone des 12 milles devrait être agréée sur le plan international.

L'importance de la pêche dans la zone côtière justifie certainement un investissement considérable pour améliorer la productivité de cette zone.

ANNEX (E) Z

Trammel bottom set catches along the eastern Adriatic coast (1971 - 1984)

by

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1. Introduction

The analyses of trammel bottom set catches along the eastern Adriatic coast, from an historical point of view started in 1960. The first results for the period up to 1970 and the results for some shorter intervals for the 1962 - 1975 period were published by Morović (1965, 1970, 1971, 1979), and later for the 1971-1981 period by Jardas (1979, 1979a, 1980, 1980a, 1982), Kačić et al. (1979) and Jardas et al. (1981).

The above mentioned authors mainly dealt with the quantitative and qualitative catch composition, changes of that composition as affected by intensive fishing and the protection of coastal fishery resources.

The analyses of catches by other gear used in coastal fishing along the eastern Adriatic coast, for the quality and quantity of fish and edible invertebrate communities (cephalopods and crustaceans), their control and protection on a scientific basis, started much earlier. The catches of small coastal trawls - "tartanes" - in the area of the middle Adriatic were analysed in the 1951 - 1953 period (Županović, 1956), catches of "migavica" (type of beach seines) in the area of the island Dugi Otok in the period 1953 - 1957 (Morović, 1962) and those of "strašin" (type of beach seine) in Split area in 1958-1961 period (Morović, 1963).

This paper presents the summary of the composition of catches realised by trammel bottom sets along the eastern Adriatic coast during the 1971 - 1984 period.

2. Area Studied

The area of the eastern Adriatic coast studied between 1971 and 1984 for catch analyses was divided into five zones (Fig. 1). The basis of this classification were the geographical and fishery-biological properties of these zones. The zones were the following:

Zone A : Eastern coast of Istra (Preluka - cape Mašnjak), the north-western coast of the Krk island, Sv. Marko island the Pag island (the Bay of Pag and part of Velebit channel). A total of 18 fishing positions. 756 trammel bottom sets were used. A total of 79 catches were analysed.

Zone B : Vir island and adjacent area, Ugljan island (cape Sv. Petar), Biograd area (Gališnjak island - Crvena luka), Pašman island (SE), Arta Velika island, Gangarol island, Kornati islands, Murter island (NW). A total of 41 fishing positions. 922 trammel bottom sets were used. A total of 92 catches were analysed.

Zone C : Middle Dalmatia : the area of Primošten, Split area, middle Adriatic channels. A total of 41 fishing positions. 633 trammel bottom sets were used. A total of 63 catches were analysed.

Zone D : The channel of Mali Ston, Klek-Neum Bay, Dubrovnik area. A total of 12 fishing positions. 216 trammel bottom sets were used. A total of 23 catches were analysed.

Zone E : Montenegro coastal area: from the Bay of Tivat to Ulcinj. A total of 12 catch positions. 260 trammel bottom sets were used. A total of 26 catches were analysed.

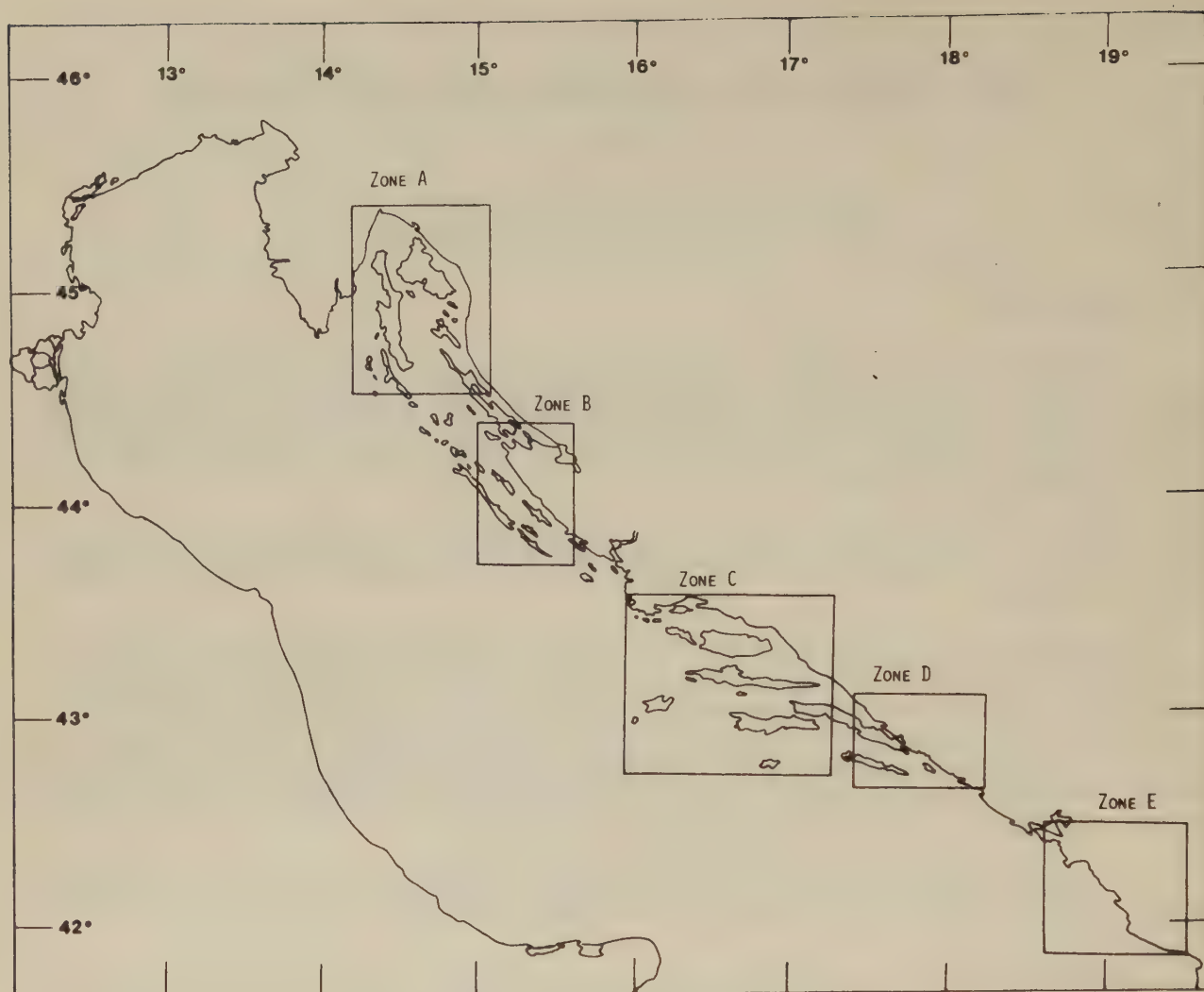


Figure 1 - Area studied, divided by zones (1971-1984).

Fishing positions within the studied zones were selected on a geographical principle. It was attempted thus to cover by fishing positions as uniformly as possible all the zones irrespective of the possible differences in their ecological and biological characteristics. In this way we have got, we hope, a sufficiently representative catch sample per zone.

3. Characteristics of used trammel bottom sets

Three types of trammel bottom sets were used. They had the following characteristics:

- a) Length: 31 m, depth: 1.3 m, interior net mesh size ("napa"): 28 mm, operational area about 40 m².
- b) Length: 36 m, depth: 1.5 m, interior net mesh size: 26 mm, operational area about 54 m².
- c) Length: 36 m, depth: 1.6 m, interior net mesh size: 28 mm, operational area about 58 m².

Trammel bottom sets are mostly used nets along the eastern Adriatic coast. Their number is not exactly known; it is assumed that sport fishing and commercial (artisanal) fishing use about 51,000 trammel bottom sets altogether.

Moreover, trammel bottom sets count among the most efficient passive fishing gears.

4. Fishing Method

Most frequently 10 or 11 trammel bottom sets were set together (86% of catches). Only exceptionally smaller series of nets were used. Nets were set from 2 m to about 30 m depth, most frequently to 15 m (80% of catches). Fishing was carried out exclusively by night, that is nets were set on the bottom in the evening and lifted during the morning of the next day (a usual way of fishing by trammel bottom sets along the eastern Adriatic coast).

Fishing was carried out on different bottom types: stony, sandy and muddy, covered by seaweed or not.

5. Results

A total of 113 fish species, 9 crustacean species and 5 cephalopod species were recorded from the catches realised from the studied area. We recorded only the commercially important crustacean species.

Catch quantities of these groups of organisms showed considerable differences, both in number and weight frequencies (Table 1, Fig. 2), from one area to another. Fish were predominant, followed by cephalopods and crustaceans. This succession of frequency of groups of organisms was recorded in all zones.

As regards fish, the group Osteichthyes was predominant. The ratio between Osteichthyes and Chondrichthyes groups varied from one zone to another. However, the frequency of the latter group did not exceed 5% in number and 13% in weight of the total catches (Table 1, Fig. 2).

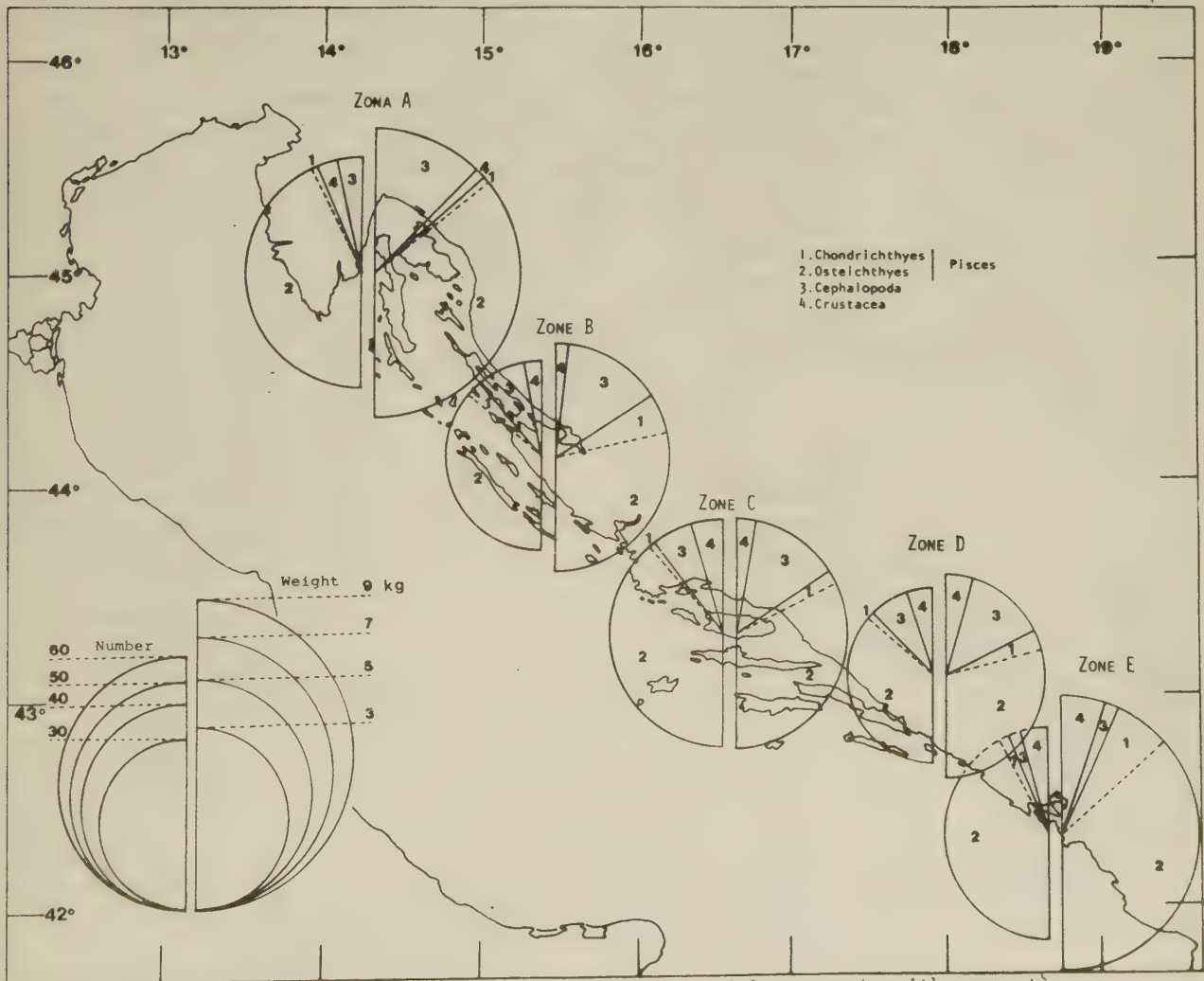


Figure 2 - Total catches (numerical and weight) by trammel bottom sets with respect to animal groups (1971-1984), recalculated per 10 nets.

Table 1 - Total catches by trammel bottom sets per zone with consideration on quantitative and qualitative structure (1971-1984)

Zone	Number of catches	Used trammel bottom sets	G r o u p	Number of species	Number of individuals	%	Weight (kg)	%
A	79	756	Pisces: Chondrichthyes	5	16	0.40	8.8	1.44
			Osteichthyes	63	3508	86.81	448.8	72.38
			Total	68	3524	87.21	457.7	73.82
			Cephalopoda	4	296	7.32	148.2	23.90
			Crustacea	7	221	5.46	14.2	2.28
			Total	79	4041	100	620.1	100
B	92	922	Pisces: Chondrichthyes	8	155	4.75	53.0	11.18
			Osteichthyes	63	2382	73.02	268.0	66.52
			Total	71	2537	77.77	321.0	67.70
			Cephalopoda	5	547	16.76	136.5	28.78
			Crustacea	7	178	5.47	16.6	3.52
			Total	83	3262	100	474.1	100
C	63	633	Pisces: Chondrichthyes	5	53	1.67	15.9	3.77
			Osteichthyes	63	2469	77.96	273.5	64.86
			Total	68	2522	79.63	289.4	68.63
			Cephalopoda	4	364	11.49	108.1	25.64
			Crustacea	10	281	8.88	24.1	5.73
			Total	82	3167	100	421.6	100
D	23	216	Pisces: Chondrichthyes	3	14	2.22	4.8	5.76
			Osteichthyes	42	471	74.05	48.9	58.18
			Total	45	485	76.27	53.7	63.94
			Cephalopoda	4	87	13.67	22.9	27.22
			Crustacea	4	64	10.06	7.4	8.84
			Total	53	636	100	84.0	100
E	26	260	Pisces: Chondrichthyes	10	36	3.17	24.4	12.6
			Osteichthyes	44	975	85.43	144.2	74.45
			Total	54	1011	88.60	168.6	87.05
			Cephalopoda	3	94	8.23	20.3	10.45
			Crustacea	5	36	3.17	4.8	2.50
			Total	62	1141	100	193.7	100

Mean total yield per catch - in this case recalculated per 10 trammel bottom sets - showed considerable variations from one zone to another. Best yields with respect to their weight were realised in zones A and E, slightly lower and approximately equal yields in zones B and C and poorest in zone D (Fig. 2).

Mean total catch weights (in kg/10 nets) were as follows:

Zone :	A	B	C	D	E
Kg :	8.2	5.1	6.7	3.9	7.4

Catches were in all zones dominated by the fish families Scorpaenidae, Labridae and Sparidae, with the Mullidae family occurring in zones C and E, Triglidae family in zone A and some others (Fig. 3).

The largest mean fish quantity per catch (in kg/10 nets) with respect to both number and weight was recorded from zones A and E (Fig. 3). Mean catch weights (in kg/10 nets) per zones were as follows:

Zone :	A	B	C	D	E
Kg :	6.1	3.5	4.6	2.5	6.5

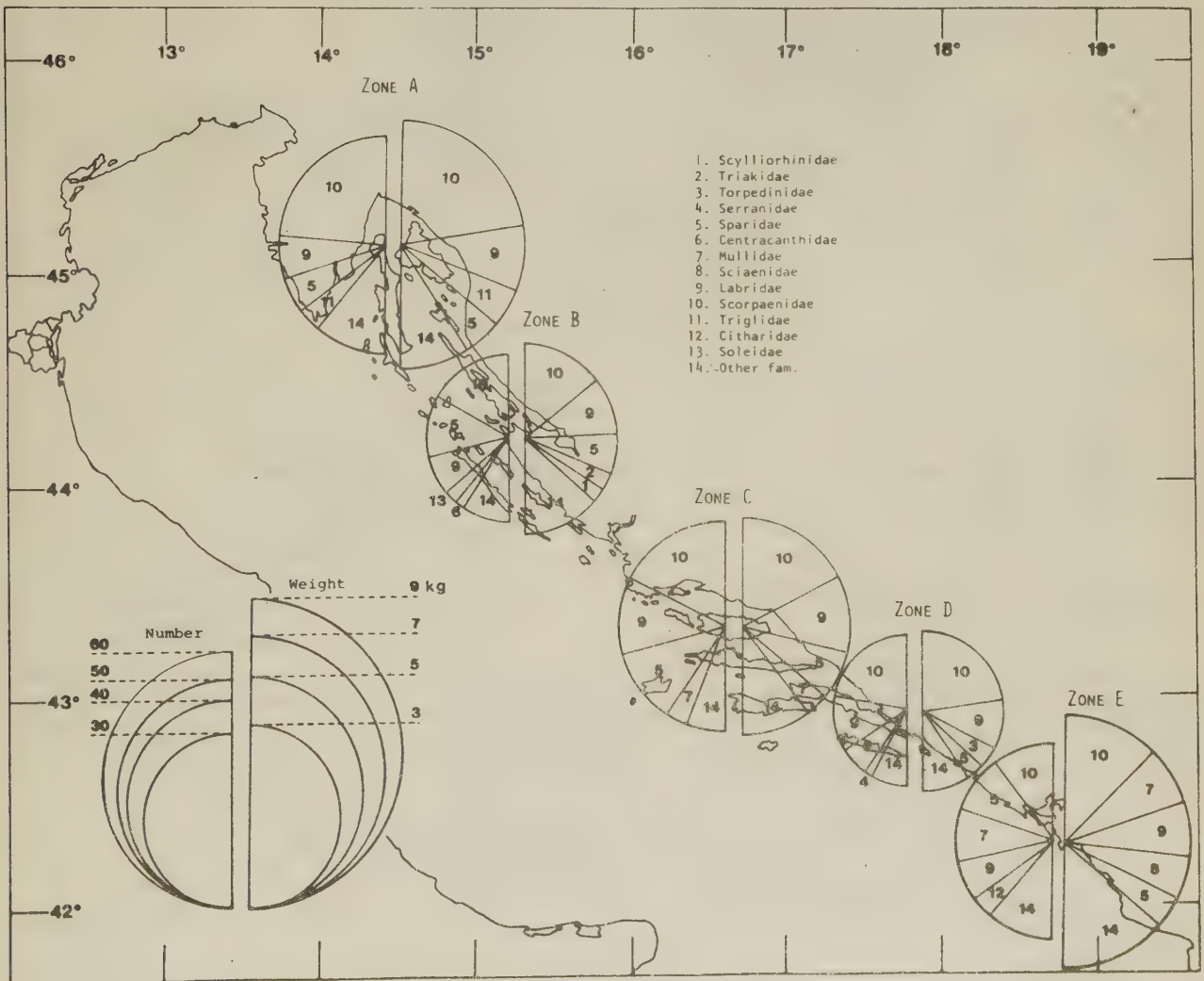


Figure 3 - Total fish catches (numerical and weight) by trammel bottom sets with respect to fish families (1971-1984), recalculated per 10 nets.

In all zones, with the exception of zone E, catches of fish were dominated absolutely by the species Scorpaena porcus and Symphodus tinca, both in number and weight frequencies. They together constituted 35.70% - 62.67% of the numbers and 32.60% - 57.85% of the weight of the total catch. In zone E, the species Mullus surmuletus, Scorpaena scrofa and Diplodus annularis showed numerical predominance and Scorpaena scrofa, Mullus surmuletus and Sciaena umbra weight predominance (Fig. 4).

The species Trigloporus lastaviza was also numerically dominant in zone A and Diplodus annularis in zones B, C and D. With respect to the weight frequency Trigloporus lastaviza was also predominant in zone A as well as Scorpaena scrofa in zones B and C.

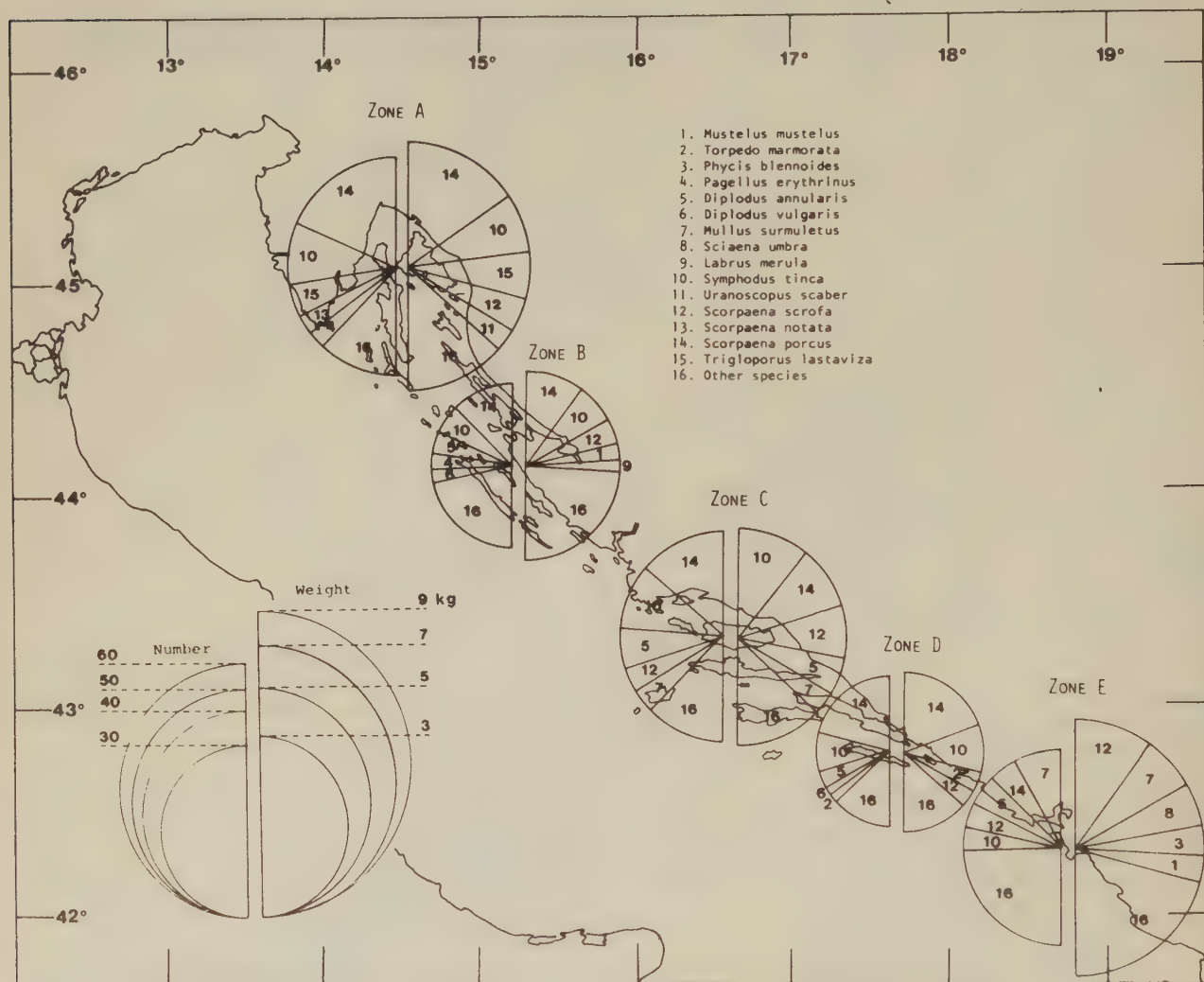


Figure 4 - Total fish catches (numerical and weight) by trammel bottom sets with respect to fish species (1971-1984), recalculated per 10 nets.

A complete list of species by frequency of occurrence in the catches from different zones is given in Table 2.

Table 2 - Total fish catches per zone (1971-1984)

Zone	No. of Catches	Total No. of trammel bottom sets	Total No. of fish species	Dominant Fish Species					
				Numerical			Weight		
					No.	%		No.	%
A	79	756	68 (86.1%)	Scorpaena porcus	1447	40.06	Scorpaena porcus	162.8	35.56
				Symphodus tinca	454	12.88	Symphodus tinca	54.3	11.85
				Trigloporus lastaviza	241	6.84	Trigloporus lastaviza	41.5	9.07
				Scorpaena notata	164	4.65	Scorpaena scrofa	31.1	6.80
				Pagellus erythrinus	153	4.34	Uranoscopus scaber	18.0	3.92
				Diplodus annularis	129	3.66	Pagellus erythrinus	16.3	3.55
				Uranoscopus scaber	118	3.34			
				Others	788	24.33	Others	133.8	29.25
				Total	3524	100	Total	457.7	100
B	92	922	71 (85.5%)	Scorpaena porcus	613	24.16	Scorpaena porcus	61.1	19.03
				Symphodus tinca	293	11.54	Symphodus tinca	43.6	13.57
				Diplodus annularis	226	8.90	Scorpaena scrofa	25.6	7.96
				Pagellus erythrinus	180	7.09	Mustelus mustelus	17.8	5.54
				Diplodus vulgaris	141	5.55	Labrus merula	16.6	5.15
				Scorpaena notata	113	4.45	Pagellus erythrinus	14.4	4.48
				Scorpaena scrofa	109	4.29	Torpedo marmorata	12.5	3.88
				Others	862	34.02	Others	129.5	40.39
				Total	2537	100	Total	321.0	100
C	63	633	68 (82.9%)	Scorpaena porcus	675	26.76	Symphodus tinca	58.1	20.06
				Symphodus tinca	498	19.74	Scorpaena porcus	57.0	19.71
				Diplodus annularis	496	18.59	Scorpaena scrofa	41.6	14.35
				Scorpaena scrofa	163	6.46	Diplodus annularis	27.0	9.32
				Mullus surmuletus	155	6.14	Mullus surmuletus	20.5	7.08
				Scorpaena notata	54	2.14			
				Diplodus vulgaris	45	1.78			
				Serranus scriba	38	1.50			
				Others	398	16.89	Others	85.3	29.48
Total	2522	100	Total	289.4	100				
D	23	216	45 (84.9%)	Scorpaena porcus	196	40.41	Scorpaena porcus	20.6	38.36
				Symphodus tinca	108	22.26	Symphodus tinca	10.5	19.49
				Diplodus annularis	39	8.04	Torpedo marmorata	4.6	8.58
				Diplodus vulgaris	12	2.47	Scorpaena scrofa	3.7	6.91
				Torpedo marmorata	12	2.47			
				Others	118	24.35	Others	14.3	26.66
				Total	485	100	Total	53.7	100
E	26	260	54 (87.1%)	Mullus surmuletus	156	15.43	Scorpaena scrofa	33.2	19.67
				Scorpaena porcus	97	9.59	Mullus surmuletus	22.4	13.30
				Diplodus annularis	97	9.59	Sciaena umbra	17.3	10.27
				Scorpaena scrofa	83	8.20	Phycis blennoides	13.5	8.00
				Symphodus tinca	80	7.91	Mustelus mustelus	11.4	6.77
				Citharus linguatula	71	7.02	Labrus merula	10.3	6.11
				Sciaena umbra	59	5.83			
				Phycis blennoides	48	4.74			
				Others	320	31.69	Others	60.4	35.88
Total	1011	100	Total	168.6	100				

Cephalopods made up from 10.45% - 28.78% of the weight of the total catch and are its significant part with respect to both quantity and quality (Table 1, Fig. 2). Mean weight of cephalopods (in kg/10 nets) per zone was as follows:

Zone :	A	B	C	D	E
Kg :	2.0	1.5	1.7	1.1	0.8

These data are also indicative of the fact that their quantity in the catch declined from north to south Adriatic. Sepia officinalis is a significant species constantly present in the catches.

Crustaceans were recorded only from some of the catches in rather small quantities. They constituted not more than 2.28% - 8.84% of the total catch weight per zone (Table 1, Fig. 2). Mean weight (in kg/10 nets) per zone was as follows:

Zone :	A	B	C	D	E
Kg :	0.19	0.18	0.38	0.34	0.18

Among the crustaceans, species of little commercial importance were mainly recorded from the catches (Maja verrucosa, Scyllarus, Eriphia, Squilla, etc.). Significant species of coastal fishing, Palinurus elephas and Homarus gammarus, were rarely recorded since they inhabit the areas deeper than those covered by our study.

5.1 Similarity of catches

The index of similarity (Qs) was used as a measure of similarity (difference) between catches from different zones:

$$Q_s = 100 (2c/a + b),$$

where a is the number of species in the catches of one zone, b is the number of species in catches of another zone and c the number of species occurring in the catches of both observed zones.

Obtained Qs values are given in Table 3.

Table 3 - Similarity index of catches (Qs)

Zone	A	B	C	D	E
A	-	77.8	70.8	68.1	45.4
B	77.8	-	76.4	60.2	51.0
C	70.8	76.4	-	71.1	59.7
D	68.1	60.2	71.1	-	52.1
E	45.4	51.0	59.7	52.1	-

Zone E catches differ notably qualitatively from the catches from other zones (Qs = 45.4% - 59.7%). Qs is better marked between the catches of other zones, particularly A, B and C zones (Qs = 70.8% - 77.8%). Qs is higher for zones which are closer geographically, and vice versa, which is in fact natural.

5.2 Changes in catch composition

A composition of catches over a rather long period (1960 - 1984) showed both qualitative and quantitative changes. They have been so far studied only in the area of Dalmatia. Morović (1965, 1970, 1971, 1979) observed a rapid decrease in the weight of total catches of trammel bottom sets and pointed out the necessity to regulate fishing in all those areas in which the yield per net was lower than 0.8 kg. The same author also found a decrease in the number, length and weight of many fish species characteristic of coastal fishing. Jardas (1979, 1979a, 1980a, 1982) recorded

further negative changes in the trammel bottom set catches after 1971, that is a further decrease of catch weight per net, as well as changes in the length and weight structure of fish species and total catch (Table 4, Fig. 5).

Table 4 - Quantitative changes in the trammel bottom sets catches from the areas of Kornati and Split in the 1960-1979 period

Catch (kg) per net	Kornati area		Split area	
	1960-1964 ⁺	1979	1960-1964 ⁺	1979
	 %			
>2.0	12.5	-	5.0	-
1.5-2.0	62.5	-	12.5	7.7
0.8-1.4	25.0	15.8	47.5	30.8
0.6-0.7	-	26.3	25.0	30.8
<0.5	-	57.9	10.0	30.0

+ according to Morović (1965)

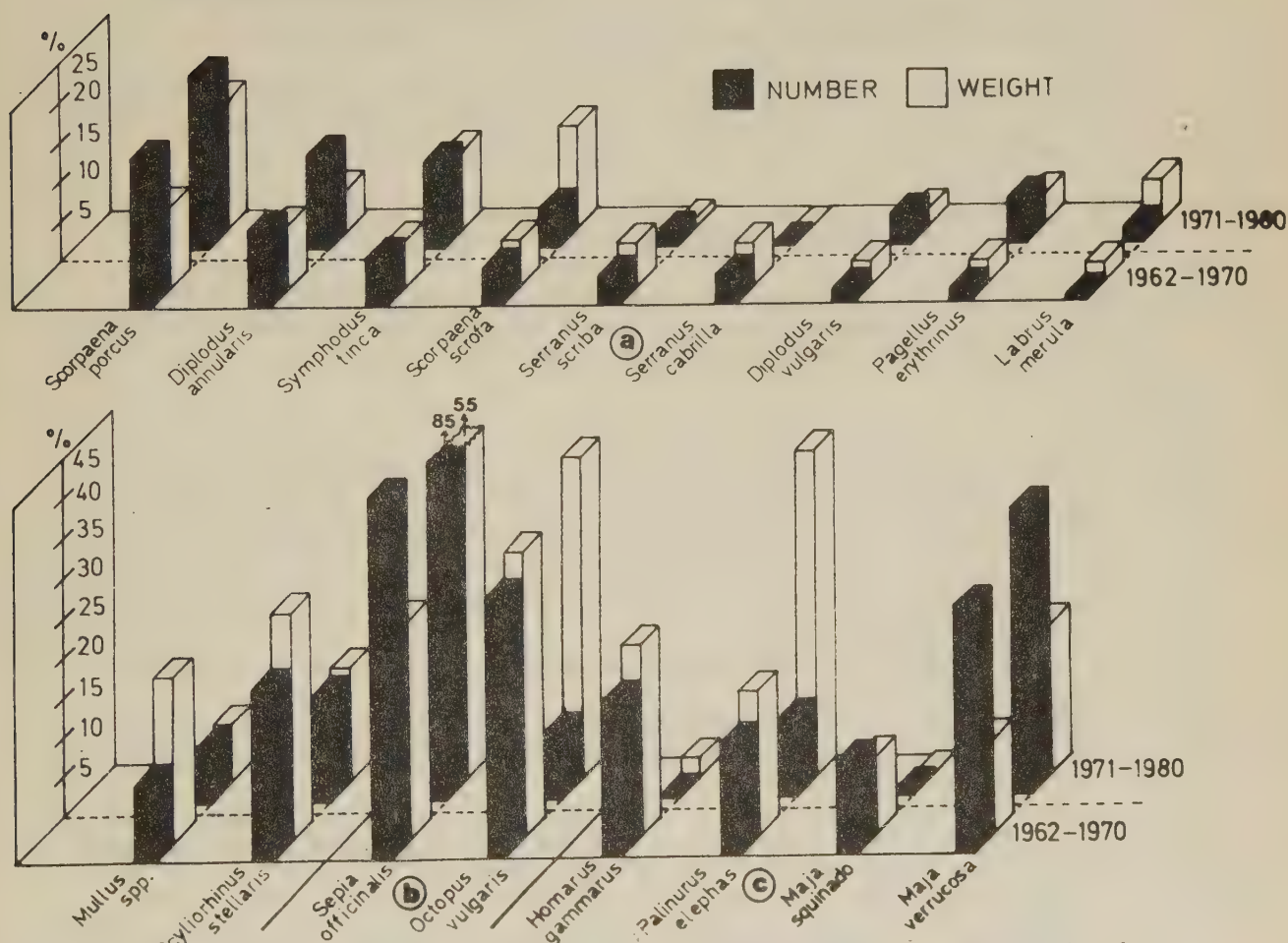


Figure 5 - Qualitative-quantitative changes in the catches of some fish (a), cephalopods (b) and crustaceans (c) in the area of the middle Adriatic in 1962-1980.

Data for 1962-1970 are from Morović (1971)

The intensity of all these changes may be indicative of the overexploitation of the communities of some areas (such as Kornati, the areas of Biograd, Split and Dubrovnik).

The observed changes frequently result from the overexploitation, use of explosives, increased efficiency of fishing gear, rather liberal laws, etc. (Grubisić, 1974). It is still unknown to what extent the growing marine pollution, particularly pronounced in the coastal area, affects the decline of biological basis of coastal fishing.

6. Conclusions

- (1) The scientific analyses of trammel bottom set catches have been continuously carried out along the eastern Adriatic coast since 1960.
- (2) The analysis of the data collected in the 1971-1984 period allowed the following conclusions:
 - (a) Mean total catch weight of trammel bottom sets by zone varies from 3.9 to 8.2 kg/10 nets. Catches are composed of fish (dominant group), cephalopods and crustaceans.
 - (b) Mean fish weight in catches of trammel bottom sets by zone varies from 2.5 to 6.5 kg/10 nets. The families Scorpaenidae, Labridae, Sparidae and some others are predominant as well as the species Scorpaena porcus, Symphodus tinca and some others.
 - (c) Mean weight of cephalopods in catches of trammel bottom sets per zone varies from 0.8 to 2.0 kg/10 nets. Sepia officinalis is the dominant species.
 - (d) Mean weight of crustaceans in catches of trammel bottom sets by zone varies from 0.18 to 0.38 kg/10 nets. The species Maja, Scyllarus, Eriphia, Squilla, etc. are predominant.
 - (e) Similarity of catch quality is better expressed between the zones A, B and C. The E zone catches differ significantly from those of other zones.
- (3) Continuous negative changes in the composition and structure of catches have been observed. Some of the areas along the eastern Adriatic coast may, due to the intensity of these changes, be considered as overexploited.

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ANNEX (E) AA

Preliminary survey on the Adriatic hake, *Merluccius merluccius* (L.), within the
Demersal Resources Assessment Programme, Spring 1985 survey

by

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1. Introduction

Demersal fish represent the most appreciated living resource of the Adriatic Sea; therefore they undergo heavy fishing pressures.

In order to properly manage this resource, the Italian "Ministero della Marina Mercantile" launched a long-term assessment research programme, covering the whole area fished by Italian local trawlers; it is carried out by several research institutions.

A preliminary joint survey was carried out in April-May 1985 by the Laboratories of Marine Biology of Fano and Bari in the Italian and international waters of the Adriatic, down to a depth of about 600 m (in the southern Adriatic).

Among the target species of the survey was the hake, *Merluccius merluccius* (L.), which is one of the most abundant and commercially important fish and is in need of management measures. In this paper the authors report some preliminary data on the catch per hour of trawl and composition by size of this species.

2. Materials and Methods

In the north and central Adriatic the survey was carried out by the Laboratories of Fano and Split, on 50 stations systematically distributed (Fig. 1); in the southern part, the Laboratory of Bari sampled 42 stations grouped on six transects (Fig. 2), from the coast line to a depth of about 600 m. In each station one hour hauls were made. The survey boats were professional trawlers using standard gear. The boat used in the north-central Adriatic had a tonnage of 70 GRT and an engine of 300 HP; the cod end had a stretched mesh size of 34 mm. For the southern Adriatic survey a 48 tons/200 HP trawler was chartered; its cod end mesh size was 32 mm stretched.

3. Results

The bathymetric distribution of the hake changes according to its growth stages and to its trophic and genetic requirements (BELLOC, 1929). Therefore, we have divided the sampled area into four bathymetrical strata: 0-50, 50-200, 200-400, and beyond 400 m of depth, in agreement with the strata reported in the "Atlas of the fisheries of the western and central Mediterranean", (CHARBONNIER and GARCIA, 1985).

The catch per hour of trawl (c/h) data are summarized in Figs. 1 and 2. Table 1 shows, for each stratum, the number of stations, the average c/h ($\bar{x}$), and its relative variance ($V/\bar{x}^2$). The overall length frequency distributions of the hake from the two parts of the Adriatic are represented in Fig. 3.

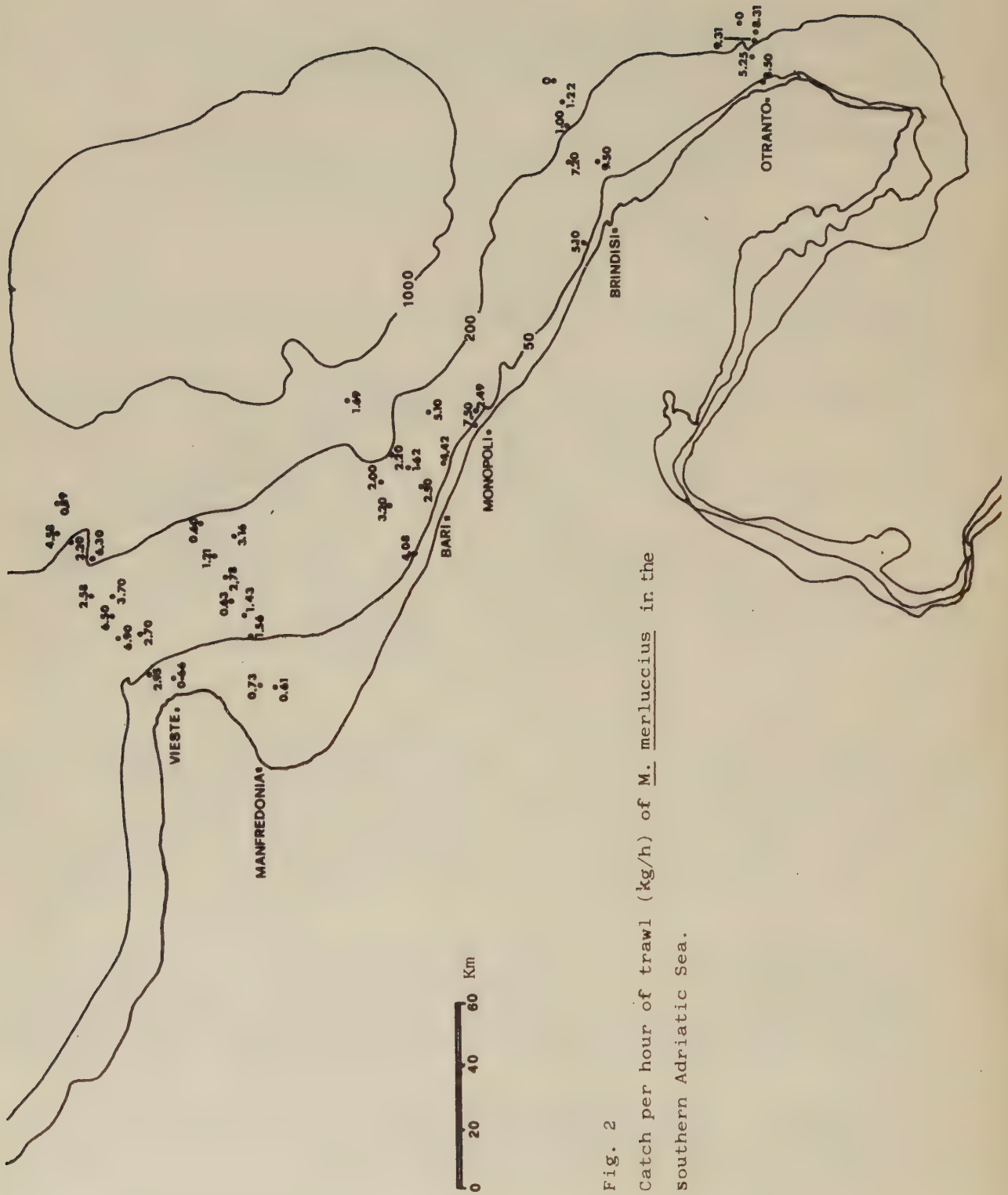


Fig. 2
Catch per hour of trawl (kg/h) of *M. merluccius* in the
southern Adriatic Sea.

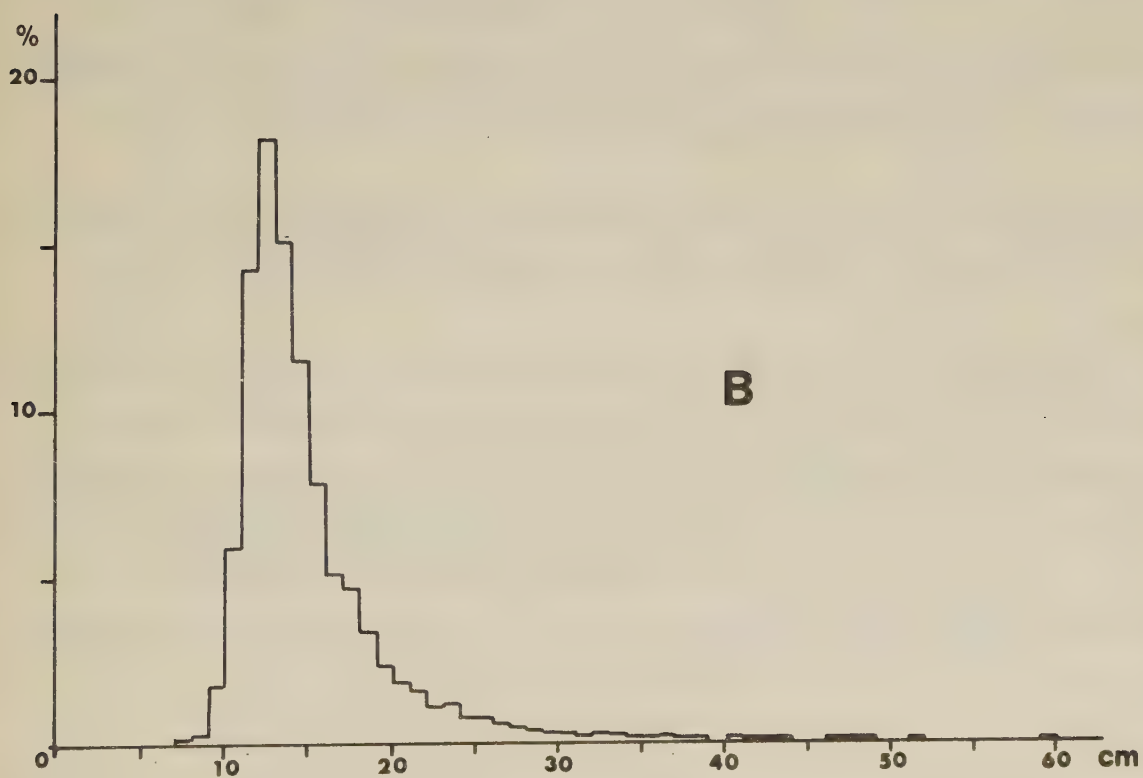
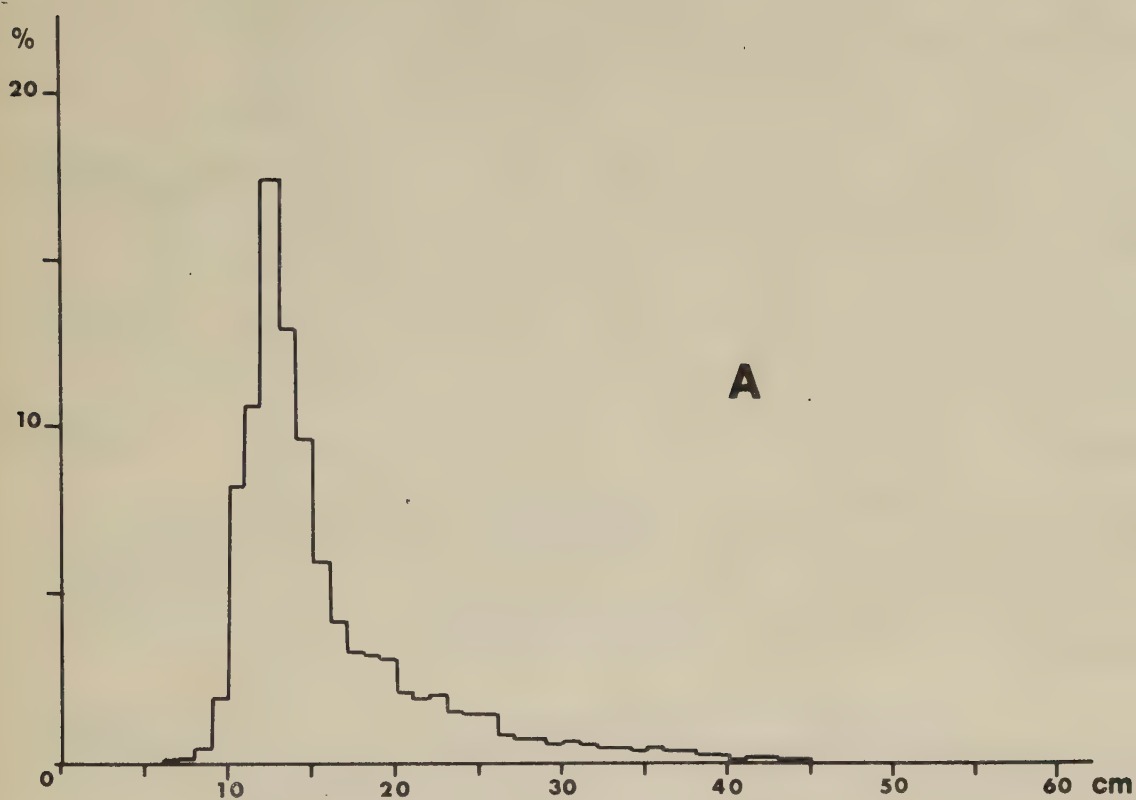


Fig. 3 - Length class frequency of *M. merluccius* (total length)

A: North-central Adriatic Sea

B: Southern Adriatic Sea

Table 1 - Catch of hake (*M. merluccius*) by stratum in the north-central and southern Adriatic Sea. $\bar{n}$ = number of sampled stations; $\bar{x}$ = mean catch per hour of trawl (c/h); $V/\bar{x}^2$ = relative variance of c/h values.

Strata (m)	North-central Adriatic			Southern Adriatic		
	n	$\bar{x}$ (kg/h)	$V/\bar{x}^2$	n	(kg/h)	$V/\bar{x}^2$
<50	24	0.91	3.25	7	2.58	0.83
50-200	23	2.53	0.43	26	3.74	0.42
200-400	3	1.78	0.22	5	4.52	0.33
>400	-	-	-	4	0.65	1.19

4. Discussion

The highest values of c/h were obtained in the strata 50-200 and 200-400, which both in the north-central and southern Adriatic are characterized by a rather homogeneous distribution of the c/h values, as shown by their relative variances (Table 1). The highest relative variance was found in the 0-50 stratum of the northern Adriatic, because of the low densities of the hake in the northernmost part of the sea: c/h = 0 in six stations and <0.5 kg/h in 11 stations (see also JUKIC and ARNERI, 1984).

The great similarity of the length frequency distributions of the north-central and southern Adriatic hake can be ascribed to comparable fishing mortalities in the two zones of the sea; in both cases the most exploited classes are 10-15 cm (total length) corresponding to the age classes 0+ and 1 (ZUPANOVIĆ, 1968; FLAMIGNI, 1984). On the other hand, the average values of c/h are always higher in the southern zone than in the north-central one, which lets us think that a possible overall higher density of hake exists in the southern fishing areas. If this last assumption is confirmed by the next surveys, a likely explanation could be in the relative extensions of fishing grounds and spawning areas in the two zones of the Adriatic, in the southern part of which the trawlable bottoms are limited by the deep south Adriatic pit.

The positive results obtained by this first joint Adriatic survey confirm the necessity to carry out surveys extended to the whole sea, in order to assess more adequately the status of the stock of *M. merluccius* and to establish, eventually, appropriate management measures.

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ISBN 92-5-002413-1